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Some fast time has recently been made by the new mail and express trains from Chicago, Ill., to Omaha, Neb., over the Chicago & Northwestern R. R. and Chicago, Burlington & Quincy R. R. The trains run in competition, carrying the cars of rival express companies. They reached Omaha on Dec. 27 after the first trip, the Northwestern train beating the Burlington train by 2 minutes, both trains running into the Union Pacific Ry. station at Council Bluffs, Ia., opposite Omaha. The time of the former was 11h. 23 mins., or at the rate of about 43 miles per hour, or an average of 46 miles per hour, deducting an hour for stops. The distance from Chicago to Council Bluffs is 490 miles by the Northwestern and 499 by the Burlington route, and while the train on the former had only one express car and two mail cars, that on the latter had six cars, so that the former had the advantage of distance and weight. According to reports the Northwestern train had an eight-wheel engine and the Burlington train a mogul engine.

Boston, Mass., has made a beginning in its subway project by taking the old Haymarket Square Station of the Boston & Maine R. R. as a northern terminal for the line. The Subway Commissioners agree to pay $750,000 for the 76,274 sq. ft. owned in fee by the railway company. The entire square containing 124,214 sq. ft. is condemned for the purposes of the commission. The station was abandoned some time ago by the railway company.

The Mount Holly and Burlington Railroad, operated by the Pennsylvania R. R. Co., as a steam railway for years, is to be converted into a trolley line, according to articles of incorporation, filed in Trenton on Dec. 23. The incorporators are Gen. W. G. Sewell and Henry D. Welsh. The line is 6 miles long.

A "bicycle railway" operated by storage batteries is being built at Waterport, N. Y., by Capt. Lina Beecher, and a short section has been put in operation for exhibition. The car used carries 25 people and runs on a single rail, being supported by a framework at the sides with rails against which wheels on the sides of the car bear to keep the car upright. It is stated that the road will be extended to Lakeside, on Lake Ontario.

The canals of New York State carried a traffic of 3,882,500 tons in the season just closed, or 449,403 tons less than 1893. The tonnage of 1894 was less than that carried in any year since 1850. The receipts of flour and grain at New York during the last year were 42,129,348 bushels by rail and 43,085,021 bushels by water. Concerning improvements in the canals of the state, Supt. Edward Hannan says in his report:

> The time is fast approaching when the operation of the canals in a practical manner must cease unless the canals are improved, for practical operation cannot continue unless the business done thereon can be done at a profit to the boatmen. That the people favor canal improvement was abundantly demonstrated at the recent election. It is clearly evident that the duty of the legislature will be to provide the measures for the construction of the largest possible canals intended for the navigation of boats of such construction as will be able to navigate the inland waters of this state, discharging and receiving their cargoes at Buffalo and New York or other intermediate points, bearing always in mind the necessity for a full and free supply of water for the navigation thereon, a careful research for the damages that may possibly occur to adjacent property in consequence of such enlargement, and with a view to the most economical method by which such a waterway may be constructed.

The most serious railway accident of the week was a crossing collision of passenger trains near Waxahachie, Tex., Dec. 25. A Texas Central Ry. train was passing slowly over the crossing when the rear car was struck squarely by a Missouri, Kansas & Texas Ry. train, which is said to have got beyond control. The car was upset and caught fire from the stove, but the flames were soon extinguished. About 16 persons were more or less injured.——On Dec. 22, a double-header passenger train on the Oregon Ry. & Navigation Co.'s line was derailed at Lenoken, Wash. Both engines and two cars were derailed, and one engineman was killed.

A traveling derrick used in the reconstruction of the Lonesome Valley trestle of the Knoxville, Cumberland Gap & Louisville R. R., broke Dec. 22, and two men were killed.

An electric car on the Cicero and Peoria line at Chicago, was derailed and upset Dec. 23 near Austin, while running at high speed, and one person was injured. It is said that the car was of the ordinary four-wheel street car pattern, and lurched badly when running fast, and that the accident was due to this lurching when the car struck a depression in the track.

A flywheel burst in the Edgar-Thomson works of the Carnegie Steel Co., in Pittsburg, Pa., on Dec. 23. The engine was a blowing engine of the blast furnaces, and the breaking down of the governor allowed the engine to run away, with the result that the flywheel broke, the flying pieces tearing out the end of the building and part of the roof, but fortunately nobody was injured. The wheel was 20 ft. diameter.

Accidents in which persons have been struck by the electric cars have been very numerous in Brooklyn, N. Y., owing largely to the speed at which the cars are run, and it is said that since the introduction of electric traction in 1892 there have been 89 persons killed and several hundred injured. For the year ending July 1, 1894, the Brooklyn Heights Ry. reported 62 such accidents, of which 23 proved fatal. The Atlantic Ave. Ry. reported 36 and 11, the Brooklyn, Bath & West End Ry., 6 and 1, and the Coney Island & Brooklyn Ry., 18 and 5.

A passenger train on the Southern Pacific Ry. went through a burning bridge near Tuscon, Ariz., Dec. 20, and three cars were burned, but all the passengers escaped.

A new fast train from Chicago to Atlanta, Ga., 733 miles, reached Atlanta Dec. 29 after having made the run in 16 h. 57 min., or 16 h. 15 min. actual running time, the average speed being 45 miles per hour. The route was over the Chicago & Eastern Illinois, the Evansville & Terre Haute, Louisville & Nashville, the Nashville, Chattanooga & St. Louis and the Western & Atlantic railways. The fastest running was between Chicago and the Ohio River, and Chattanooga and Atlanta.

Frozen hydrants were responsible for considerable fire loss at Buffalo, N. Y., on Dec. 27. The fire was already well under way when the firemen arrived, but with all the apparatus brought out by a third alarm only two or three hydrants were available for a considerable time.

An issue of $4,000,000 of bonds is advertised for sale by the Sanitary District of Chicago, the money for which is to be used in constructing the Chicago Main Drainage channel. Bids are to be received up to Jan. 9, and are asked for four different classes of bonds, viz., bearing interest at 4½ and 5%, and payable either in gold or in "lawful money." The bonds will be issued in denominations of $1,000, with interest payable semi-annually, and $200,000 of the principal is payable each year. The bonds will be sold in lots of $25,000 or multiples of that sum. This is the fourth issue of bonds made by the district, and brings the total amount of bonded indebtedness up to $12,000,000, neglecting the $350,000 canceled by the failing due of a certain amount each year.

The design for a swing bridge made by Mr. C. L. Strobel, M. Am. Soc. C. E., for the trustees of the Chicago Drainage Canal was adjudged the best of the designs received by the trustees for bridges across the line of the canal. The proposition to award Mr. Strobel a premium of $750 was defeated by a vote of 4 to 3, the opposition holding that as the construction of swing bridges had been indefinitely postponed, no prize for the design should be awarded. The lowest bid for the construction of the swing bridges was submitted by the Chicago Bridge Co.

A piece of ice about the size of a small pecan nut is reported as having been found a few days ago inside a bowlder 3 ft. in diameter, excavated from a point 31 ft. below the surface, on the Chicago Drainage Canal. The story goes that Mr. E. Schnable, an engineer employed on the work, and a Mr. Joseph Little, were examining some curious pockets of asphalt and petroleum in fragments of the bowlder, which had been blown to pieces by a dynamite cartridge, when the ice was picked out, and was at first supposed to be a crystal of some mineral. The ice was found about 4 p. m. At 5 a. m., of the same day the thermometer registered 35° above zero. In our issue of Nov. 15, 1894, a correspondent reported finding ice on Oct. 13, 1894, while excavating in a sewer trench 14 ft. below the surface at Baton Rouge, La., in a latitude where ice and snow are seldom seen.

A more perfect sanitary disposal of Chicago's garbage is being urged by the Civic Federation of that city. Some time ago this body appointed a committee to look into the methods adopted by the city for collecting and disposing of its garbage, and at a meeting held Dec. 28, this committee made an informal report in which was brought out a most disgraceful state of affairs in this work. The city, which is paying a dozen or so contractors for collecting the garbage, besides a large force of ward foremen and inspectors, is being swindled right and left by both contractors and employees. Not more than half of the work for which it pays is being done. The city is divided into a number of districts and a contract is let for collecting and removing the garbage from each of these districts. These contracts call for a collection every day in the first ward, and three times a week in all other wards, except in some of the outlying districts, where two collections a week are allowed. From weekly reports made by agents of the Civic Federation it was found that only about one-half of the services for which the contractors were paid were rendered. In some parts of the city not even one collection a week was made. In fact, the contractors with a "pull" collected garbage when they wished and let it alone when they wished, and the ward foremen, who received $1,000 a year to see that the work was properly done, "stood in" with the contractors in violating the contract. The Civic Federation asks that instead of a number of contractors, the city arrange with one firm to collect the garbage, and instead of being dumped to putrefy in heaps, it be cremated or otherwise destroyed or rendered harmless, and that this company be put under heavy bonds to insure a satisfactory performance of their contract. A number of companies have signified their willingness to enter into a contract of this character.

PLATE GIRDER SWING BRIDGE OVER BRONX RIVER, NEW YORK CITY.

(With inset.)

We illustrate on our inset sheet this week the principal details of a heavy four-track plate girder swing bridge recently constructed across the Bronx River near New York city by the New York, New Haven & Hartford R. R. Co. Aside from the length of the main center girder, 176 ft., and the great weight of the structure, 550 tons, the principal points of interest are found in the design and operation of the turning and locking machinery. Briefly described, the bridge consists of three girders, placed 28 ft. 6 ins. apart, making the total distance, c. to c. of outside girders, 57 ft. Two main cross girders serve to convey the weight of the side girders to the drum. The bridge girders are bound together by a floor system of beams and stringers, and by a system of bottom lateral bracing.

A half elevation of the main center girder of the bridge is shown in Fig. 1. This girder is 176 ft. long between backs of end stiffeners, and is 9 ft. ½ in. deep at the center, 5 ft. 6½ ins. deep at the ends, and has a curved top flange with a radius of 1,108 ft. The make-up of the girder is plainly shown by the drawings, and the composition and design of the two side girders are much the same, except that they are 9 ft. 3 13-16 ins. shorter, and lighter in proportion to their length and the loads they have to carry. The weight of the two outside girders is carried to the drum by two cross girders. A half elevation of one of these cross girders is shown in Fig. 2. Fig. 3 shows one of the main floor beams with its connections for the stringers. The end beams connecting the ends of the main center girder with the ends of the side girders are slightly heavier, and of course longer, than the main beams, but are otherwise exactly the same in design and make up. All the floor stringers, whatever their length, are 24½ ins. deep, with 6×4×½-in. angle flanges and 24×7-16-in. webs. Fig. 4 shows one of the radial truss stiffeners for the drum and the general details of the center casting, rollers, track, etc.

The motor house from which the bridge is operated is carried on a platform built transversely across the bridge and 20 ft. 6 ins. in clear above the base of rail, as shown in Fig. 5. This drawing shows the manner of supporting the platform on the girders, the construction of the iron plate and concrete floor of the motor-room, and the general arrangement of the shafts conveying the power from the motor-room to the turning and locking machinery under the bridge floor. The most convenient manner of studying the operating machinery is to follow the trains of gearing from the motor-room to their points of action.

A single horizontal shaft A, passing transversely across the bridge, actuates both the turning and locking machinery. To operate the turning machinery, this shaft connects by bevel gears at its ends with the vertical shafts B, B, (Fig. 5), which pass down just inside the side girders and end in pinions just underneath the bottom flanges of this girder. This pinion gears with a spur operating a shaft, C (Fig. 6), which in turn meshes through a pinion with the rack of the turn-table. In case the machinery becomes injured so that the bridge cannot be turned by power, there are two hand-turning devices of the form shown in Fig. 7.

The locking machinery is somewhat more complicated. To operate this, the shaft A gears with the two vertical shafts D, D (Fig. 5), which pass down opposite sides of the main center girder and connect with the right and left transverse shafts E, E (Figs. 5 and 8). Referring to Fig. 8, the shaft E connects with the shaft F, and this operates the two shafts G, G, running to the locking mechanism at opposite ends of the bridge. Fig. 8 shows the mechanism on one side of the center girder only, but it is exactly alike on the other side, as the general drawing, Fig. 5, indicates. There are, therefore, four shafts, G, operating four separate and independent locking and rail-lifting devices.

One of these locking devices is shown by Fig. 9. The shaft G operates the shaft K by a worm gearing, and the motion of K is communicated to two systems of levers, one of which unlocks the bridge and the other raises the rails. Taking the unlocking device first, the shaft K moves the lever R, and this pulls on the rod and keys, S, S, which support the ends of the girders. In raising the rails, the lever L, which is keyed to K, operates through the rod M the lever N, which is keyed to the shaft O. The movement of O raises or lowers the levers P, P, and consequently the bar Q, supporting the rails, to which they are attached. By comparing the numbers of the floor stringers in Fig. 9 with those in Fig. 5 there need be no confusion in understanding the location of the end locking mechanism.

The bridge is operated by electricity taken from the city wires and running a 25-HP. single reduction street railway type electric motor. This motor, it may be noted, is guaranteed to develop 43 HP. although it is nominally 25-HP., as stated. Shortly after the completion of the bridge some tests were made to determine the time of opening and closing it with this mechanism. The results were as follows:

Opening	HP.	—Time.— min.	sec.
Maximum power to start bridge.....	29.7	..	..
To lift rails and draw wedges (av. HP.)	9.1	0	30
To open bridge (average HP.).....	19.3	1	40
Closing.			
Maximum power to start bridge.....	36.3	..	..
To close bridge (average HP.).....	20.8	1	50
To drop rails, put in wedges (ave. HP.)	8.9	0	30

When the bridge was first swung, and before it was painted, it was found that when the sun shone the difference in temperature between the top and bottom flanges caused the ends to sag ⅜ in. below their normal position. The painting of the bridge white removed a little more than half of this sag. The metal is all wrought iron, with the exception of a few of the larger web plates, which are soft steel.

The bridge was built by the Passaic Rolling Mill Co., of Paterson, N. J., as sub-contractors for Post & McCord, of New York city. Mr. S. L. F. Deyo was the engineer in charge of the work for the New York, New Haven & Hartford R. R. Co. We are indebted to Mr. F. S. Curtis, M. Am. Soc. C. E., and Mr. Wm. Harley Moore, respectively, Chief Engineer and Engineer of Bridges of the same road, for the matter from which our drawings and accompanying article have been prepared.

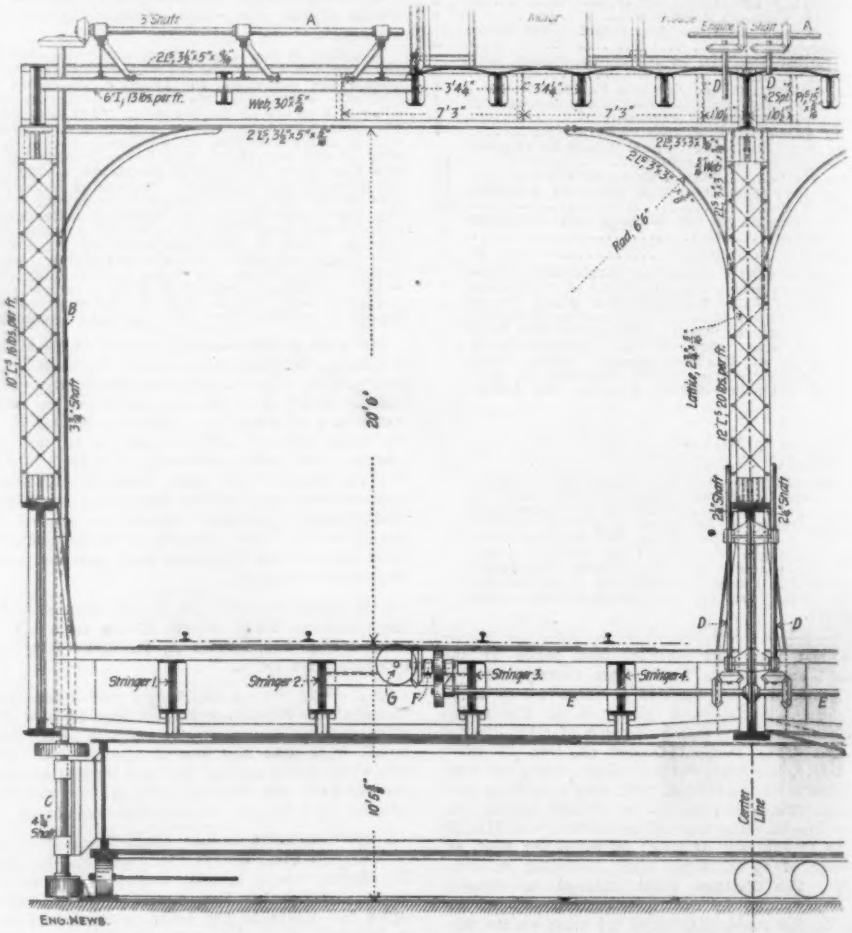


FIG. 5. TRANSVERSE SECTIONAL ELEVATION OF BRIDGE AND MOTOR HOUSE.

TRACKLAYING BY MACHINERY.

While tracklaying machines have been very extensively used on large railway contracts, mainly in the western states, comparatively little is known by engineers generally of their operations. The common system of tracklaying is to have the ties hauled onto the grade by teams, and the rails run forward on small hand cars. For long stretches of work, however, and in difficult country (rugged or swampy), especially where teams cannot be used to distribute the ties ahead in the usual way, machine tracklaying is very extensively employed and permits great rapidity, with a saving in cost over the ordinary method. The title "tracklaying machine" is rather an incorrect one, since the machine does not lay the track, the general principle of the system being that the ties and rails are run to the front of the supply train on rollers or tramways laid along the cars, and are delivered to the tracklaying gang from a frame projecting in front of the first or pioneer car, this car or "machine" forming the head of the material train, which is pushed forward as fast as the track is laid, moving one or two rail lengths at a time.

The quality of the work depends upon the speed of operation and the method of working. In some cases the whole number of ties for each rail is laid ahead of the train, while in other cases only half the number are laid, and the balance are slipped in endways by a rear gang following the train. As a general principle it is always best to get the full number of ties laid ahead, as a better track is obtained in this way, and there is less liability to injure the rail by surface kinking. We give herewith descriptions of three forms of tracklaying machines, with details of the methods of operation, and some further remarks on the subject will be found on our editorial page.

The Holman tracklaying machine is composed of a series of tramways 30 ft. long and about 20 ins. wide, fitted with heavy iron rollers, and these tramways are attached to the sides of ordinary flat cars, without any changes, being supported by adjustable iron stakes that fit into the pockets on the sides of the cars. The sections are connected and

operate the full length of the train, as one continuous tramway. The ties and rails on the supply cars are thrown upon these tramways and rolled down to the front, where men receive and place them in position on the roadbed. The ties come down on one side of the train and the rails on the opposite side. The tie tramway ends in a chute, supported by a wire cable, which runs out 35 ft. in front of the train, so that the men handling the ties are one panel ahead of the rail men, and consequently the gangs are out of each other's way. As each rail comes down the chute it is seized by the rail men, placed on the ties, and pushed back against the end of the last rail, the expansion spacing being arranged by the joint gang.

The pioneer or pilot car at the head of the train is fitted with an elevated frame or trestle from which the chutes forming the ends of the tramways are suspended, and on this frame rides a brakeman who signals the engineman when to push ahead, and attends to the brakes on this car. The splice bars, bolts, and spikes are carried on the pilot car. A train of ten cars (six cars of ties, three cars of rails, and the tool car) will carry all the material required for a half-day's work and from half to three-quarters of a mile of track. From 1¼ to 1½ miles of track per day can be laid with this machine, or even two miles with from 40 to 60 men, provided the railway company can deliver the material at the front fast enough, and in proper shape. This includes the full supply of ties, laying the rails in position; joint, quarter, and center spiking; putting on the fish-plates or angle-bars, and putting two bolts through the same. This leaves the track in safe condition for the construction train to pass over, and the balance of the work is finished behind the train without reference to or use of the train. As fast as the panels or rail lengths are laid, the train moves forward 30 ft. at a time, carrying all material with it, leaving nothing scattered along the line. The main objects of the machine are to dispense with the use of teams in the distribution of material and to reduce the cost of railway building, both of which it does effectually, and it is claimed that from $50 to $200 per mile can be saved by its use. The patents on this machine are owned by Mr. D. F. Holman, of Chicago, Ill.

The engineer's report of tracklaying done with one of these machines by Nelson Bennet on the construction of the Cascade Division of the Northern Pacific R. R. on March 30, 1886, showed that the amount of track laid was 8,400 ft. Actual time occupied in laying, 8 hours. This track was laid in strict accordance with the specifications, full tied, full bolted, full spiked, ties accurately spaced, the track properly lined to center, and expansion spacing attended to. The working force comprised tracklaying machine, 1 foreman and 66 men, distributed as follows: In front of the machine: 1 tie man, 8 tie carriers, 2 bolters, 4 spikers, 1 chute man, 6 rail carriers, and 2 nippers. On the train: 2 men unloading rails, 2 men pushing rails, 16 men handling ties. Behind the train: 2 spacers, 8 spikers, 3 bolters, 4 nippers, 4 liners, and 1 spike peddler. On this day the boarding train was about five miles in the rear, two hours were consumed in going to and from work, and making up train, leaving 8 hours actual working time. Experience with the tracklaying machine showed that good work could be done as cheaply and speedily as poor. Where the grade was freshly trimmed, a gain of 1,500 ft. per day in tracklaying could be made. He was satisfied that under favorable circumstances 100 stations could be laid in a day of 10 hours.

Another of these machines was used on the Pacific extension of the Great Northern Ry., and during the short days of the winter of 1890-91 the contractors laid with it in 82 days an average of over 1½ miles of track per day, and in 25 days laid within 1,000 ft. of 50 miles. The most of this work was done in November and December, and under the usual disadvantages attending work at that season of the year. Mr. N. D. Miller, Chief Engineer of the Great Northern Ry., writes us that in timber or broken country, where it is difficult to get in with teams to lay ties, the work can be done cheaper with the Holman machine than it can by handling the ties. The machine can be used to advantage to lay from 1½ to 2 miles per day. If necessary to lay more than this (which would be exceptional), as a general thing, it would be cheaper to lay by hand, using hand or rail cars, although on his road they have laid as much as three miles per day with one of these machines, but the track was not fully spiked or tied. To lay from 1½ to 2 miles per day about the following force would be required.

48 Tie men	3 Spike peddlers
8 Iron men	12 Wrenchers
9 Nippers	1 Shim peddler

16 Spikers (or 18 if there is much curvature)
16 Men handling iron on the cars and carrying it to the front.

They would require about nine cars of ties and six cars of rails. On light grades one engine can handle this outfit, a supply train bringing the material to the nearest siding to where rails are being laid. This is only a general estimate, varying according to the ground and the kind of roadbed. On ordinary work he considers it cheaper to lay with the machine than with iron cars, while the roadbed is in better shape for the track than it would be where ties are hauled by team.

The Burlington & Missouri River R. R. has laid its own track for the last eight years, and its last contract for tracklaying by hand, before that time, was let at $300 per mile, which included loading track material and higher wages than these now ruling. Both the Holman and Harris tracklaying machines have been used, and the former was used on the Billings extension, built this year. Mr. I. S. P. Weeks, Chief Engineer, states that the speed of the Holman machine, with a force of 85 men, is 1½ miles per day, which is the most convenient speed, and the cost at such rate is about $100 per mile. For this rate there is a morning and an afternoon train, each made up of four flat cars of rails and four flat cars of ties ahead of the locomotive, and four box or flat cars of ties behind the engine. On the Billings extension the track is laid with 65-lb. rails, and 18 ties to a rail, or 3,168 ties per mile. The track is half-tied in front of the engine, the balance of the ties being put in by lifting the rails and dragging the ties into place endways. Curves of 1° to 16° were laid without any special arrangement. Mr. Weeks states that, if it should be desirable to lay 2½ miles of track per day, it could be done by working two shifts of men with the Holman machine, laying 1¼ miles each in morning and afternoon. With the Harris machine, he has laid 2½ miles per day on a spurt, when ties were distributed ahead of the track. This machine has been used with very satisfactory results, and at about the same expense as the Holman for a rate of 1½ miles per day. With the Holman machine there are 85 men, distributed as follows:

Tracklaying Gangs with Holman Machine; B. & M. R. R. R.

41 Men in Front of the Engine.	44 Men Behind the Engine.
1 Foreman	1 Straw boss
1 Heeler	2 Tie unloaders
4 Spikers	2 Tie placers
2 Nippers	4 Tie spacers
1 Rail thrower	2 Rail lifters
1 Spike peddler	12 Spikers
1 Gage carrier	6 Nippers
1 Expansion driver	2 Spike peddlers
2 Fork men	4 Bolters
4 Rail pullers	1 Gage carrier
1 Line man	2 Spike pullers
1 Pole man and tie marker	1 Water boy
	4 Liners
4 Tie carriers	
2 Tie spacers	
1 Tram tender	
1 Bolt trimmer	
2 Bolters	
2 Strap carriers	
8 Tie pushers	
2 Tie loaders	
1 Water boy	

With the Harris tracklaying machine ordinary 34-ft. flat cars are used, with four or five bridge ties, 6×8 ins. and 11 ft. long, laid across the floor, at proper intervals, and bolted to place. Ordinary 30-ft. rails are spiked to these at about 8 ft. or 8 ft. 6 ins. gage. Fish-plates are attached to the ends of the rails by a single bolt through the end hole in rail, and end holes in plates, thus causing the plates on adjacent cars to project toward each other as far as possible. The gap in the track between cars is then filled by short rails, having 18 ins. of the base cut off at each end, to permit of dropping the web into the slots formed by the projecting plates attached to the ends of the fixed rails on each car. These connecting rails are cut short enough to avoid jamming when all slack in car couplings is closed up to the minimum. Ten pairs of the short rails will equip a train of material, and they are always retained at the front, for use on each train while unloading. Along the middle of each car carrying rails are four or five iron rollers, 3½×1[illegible] ins., attached to the cross-ties along the deck of the car, forming a runway for conveying rails to the front. The rails are loaded in two neatly made piles, one on each side of the car, so as to clear the rollers in the middle and the tram rails on the sides of the car, the middle runway being about 24 ins. wide. Each car carries the proper complement of splice bars, stored in the open spaces between the cross-ties, while spike and bolt kegs are loaded in the runway between the rail piles and are afterwards moved to the end of the car, preparatory to unloading when the train reaches the front. The cars for the ties have the tramway, but no rollers. The front or "pioneer" car, besides being fitted with the rail rollers and tie tramway, has a frame of long stringers attached to the front end, to extend the tram track about 15 or 20 ft. ahead of the car. The front ends of the stringers are supported by truss rods, extending over a light trestle 10 ft. high, near the middle of the car, and securely fastened at the rear end of the car. A stout cross-beam on the front end of the stringers has a short timber extending downward in middle, to support a double-ended roller about 2 ft. below the level of car deck. Two portable "dollies" are used at intervals of 15 ft. ahead of the car, placed in the center of the roadbed. These are light trestles or towers, about 3½ ft. high, with a roller about 4×18 ins. on top of each. The 8-ft. gage truck or tram, for conveying the ties forward along the train and dumping them at the front, has a platform about 5×9 ft. and is fitted with a double frame, so arranged that the top frame is permitted to slide forward on rollers about 3 ft. when the wheels strike the chock block on the front end of the dumping frame in front of the pioneer car. This shifts the load forward, causing the car to tip downward in front, so that the load slides off onto the roadbed, after which the car tilts back level, and the men slip the top frame back to its normal position, while returning for the next load of ties. Owing to the width of this tram, the men on the rail cars have to move back onto planks laid on the ends of the 11-ft. ties to let it pass. Another truck with a plain single frame is used to good advantage in conveying ties part way from the tie cars to the front, the load being transferred to the dump car at the meeting point. This second car is a little higher than the dump car, to permit of transferring the load by simply sliding the ties from the higher car to the lower one. These tie trams and the pioneer car are always kept at the front end of the track. Material for a mile of track is loaded on 15 cars behind the pioneer car, as follows: 5 flat cars carrying 72 rails each, 5 flat cars carrying about 300 ties each, and 5 (sometimes 7 or 8) box cars with a total of about 1,500 ties. The engine is placed at the rear and the train pushed to the front, with the cars arranged in the order named. After coupling to the pioneer car, the short connecting rails are adjusted in the tie-tram track, spike and bolt kegs are taken from the runway and stored on the ends of the cars, and the tie tram is run back to the cars and loaded. One man with a rail fork throws two rails from each of two of the rail cars onto the rollers, when four men pull these four rails forward to the pilot car, where 2 more men on the rear end put on the splice bars and two bolts, and put in the expansion shims. The man on the rail car also throws off the splice bolts and spikes, as required. Meanwhile 16 to 18 ties (for two rail lengths) have been loaded on the tram and the rail men step aside to let it pass, as it runs out onto the frame beyond the pilot car and dumps its load onto the ground, when the tie men distribute them over 60 ft. of the subgrade. When the tram is run back, the four rails bolted together are run forward over the dumping frame rollers onto the portable "dollies," until the rear ends are clear of the car. The rails on the line side are then lifted from the rollers and dropped on the ties, thrown back against the last rails laid and fastened to the latter by one bolt through the splice bars previously bolted to them. While the gage rails are being laid in the same way 4 men are spiking the line side at 3 or 4 ties per rail (quarters and centers), and 4 more follow with gages and spike the gage rail. At the same time 2 men are putting expansion shims at the heel joints of the two-rail sec-

tion and half-bolting up these joints, and 2 more are putting the splice bars on the front end of the section, while others are moving the dollies ahead. A flagman near the front end signals the engineman when to stop and start, and the train is now moved ahead 60 ft., bringing the front end of the pilot car about 8 ft. from the end of the last rail, when another load of ties is dumped as before.

Meantime, a few men in two of the box cars at the rear of the train drop off eight or nine ties per rail length at each move of train, while a man on the ground alongside sees that the ties do not go down the embankments, and also that no more or less than the proper number are dropped off. A few men with picks and four quick-working ratchet jacks follow immediately in the rear of the train, putting in the back ties, and those are followed by the back bolters, spikers and lining gang, who complete the work in the rear as fast as it is strung out at the front. In other words, track is only half-tied, half-bolted and quarter-spiked in front of train. Material to complete the work is distributed from train as it advances, and the back gang keeps the work completed close up to the rear of the train.

For quick work two tie trams may be used when the front cars of ties are unloaded, the front one being the dump tram, and each load being transferred from one tram to the other. This plan, with a long train, is said to save two hours a day and to enable 2,000 ft. more track to be laid than with one tram. With this system of working, as above described, the organization of force for laying two miles of track per day on the Chicago, Kansas & Nebraska Ry., in 1887, was as follows:

On the train: 2 bolters, 4 or 6 rail pullers, 1 man throwing rails on rollers and dropping off bolts and spikes, 6 men handling ties and running the tram (or 8 men with two trams); 13 to 17 men in all. In front of the train: 8 spikers, 4 nippers, 12 rail men, 2 bolters, 2 men moving the "dolly," 1 handling the tie line, 1 handling the 30-ft. pole and marking the ties, 1 spike peddler, and 1 water boy; 31 in all. Behind the train: 4 bolters, 12 to 14 men with two track jacks and some picks, pulling in and spacing the additional ties, 16 to 20 spikers, 8 to 10 nippers, 5 liners, 2 spike peddlers, 1 tie marker and 1 water boy, or 49 to 57 in all. The complete crew would consist of 1 general foreman, 1 heeler acting as foreman of the front gang, 1 foreman in charge of the back spikers, 1 foreman of tie gang, 1 sub-foreman lining track and 100 to 115 laborers. The tie markers carried a measuring board, which they placed on the line end of every tie and struck a chalk line across 16 ins. from end of the tie to guide the spikers in keeping ties in line.

With 4 quick bolters in front, easy-fitting bolts, and a well-trained front gang, a 60-ft. section, or "set-out," was often laid in 2½ minutes for hours at a time, the train being moved up as fast as the men could handle the material. Owing to delays in switching and running to and from work, the force never worked 10 hours consecutively, but over two miles of track were usually laid in 9 hours' steady work, and some of the records were as follows: 1,300 ft. in 30 mins., 5,600 ft. in 4 hrs. 5 mins., 11,100 ft. in 8 hrs. 30 mins., and 11,000 ft. in 8 hrs. 55 mins. It was estimated that over 12,000 ft. could be laid in 10 hours, at a cost of $240 for gang and foremen; adding to this the cost of motive power and trainmen and the expense of loading cars, the cost was estimated to be somewhat less than $150 per mile. The half-tieing is, of course, a disadvantage.

The Chicago, Rock Island & Pacific Ry. constructed about 1,300 miles of track with the Harris machine in 1886 and 1887, the results being satisfactory in point of cost, speed and quality of work. We are indebted to Mr. D. Sweeney, Division Roadmaster of this road (and who was in charge on the work on the C., K. & N. Ry., above noted), for much of the above information, as well as for the following detailed particulars:

It requires not fewer than 100 men to work this system to its full capacity, which is a little upward of two miles per day. The front bolters must be sufficiently expert to splice a joint with two bolts moderately snug in every 2½ minutes; failure on their part will delay the entire work. Rail pullers and tie-tram men must be lively workers, but the men on other parts of the work can keep up by moderate effort. The average cost of laying two miles of track per day by this method is about as follows:

1 general foreman,	average rate,	$5	$5
2 assistant foremen,	" "	3	6
109 laborers,	" "	2	218
1 eng. and train crew	" "	20	20
Total for two miles			$249

To this must be added a small amount per mile as royalty for use of the "machine," and about $10 per mile for preparatory work in transferring material to the cars in yard, all of which will bring the actual cost to about $140 per mile where work is properly handled and not subject to much interruption or delay.

The Chicago, Rock Island & Pacific Ry. has also constructed about 200 miles of track with the Holman machine during the past few years. This was done in a leisurely way and in short patches that did not justify equipping cars for the Harris system. The general working of the Holman system has already been described, but on the C., R. I. & P. Ry. the track was not full-tied ahead of the train. After 8 or 9 ties were delivered and spread on a 30-ft. section of roadbed, the rails were heeled to place, one at a time, and spiked to four ties, the train being then moved forward 30 ft., and the process repeated until material runs out. The back tieing and finishing up were done in the same manner as with the Harris machine. The average capacity of this system was about one mile per day with 60 to 70 men, which is about as many as it will employ to advantage. Following is approximate cost of work per day:

1 general foreman,	$5		$5
2 assistant foremen,	3	each	6
70 laborers,	2	"	140
1 eng. and train crew,	$20		20
Total for one mile			$171

It will be seen here that it costs as much for train and foremen in laying one mile with the Holman as it does to lay two miles with the Harris. Still, the Holman is the more economical for short stretches, or in cases where tracklaying is subject to frequent delays awaiting material, or the completion of grading and bridges. The gang is comparatively small, has few places requiring specially-trained men, and would be subject to little loss or demoralization in changing from tracklaying to surfacing, and vice versa. It is probable that the capacity of the Holman machine could be largely increased by making slight changes in the machine and method of working it. But either of these machines will lay track more economically than it can be done with iron cars. This system does away with the heavy expensive team work and cutting up of the roadbed incurred in hauling ties ahead of the track. It also prevents leaving large piles of surplus material scattered behind the tracklayers to be afterwards picked up at considerable expense, or else wasted.

A considerable saving in time and expense can be effected in any system of tracklaying by only half tieing in front of the construction train and having the balance of ties dropped systematically from the train, so as to place opposite each rail length the exact number required for completing each panel of track. This lightens the work and increases the headway of the front gang, and materially speeds up the entire work. People who are accustomed to laying the full complement of ties and bedding them under a straight edge before rails are laid, will fear that this method would lead to the rails becoming surface bent, etc. I used to feel that way myself until convinced by experience that with a smooth roadbed, ties of fair average size, and a steel rail of not less than 60 lbs. per yd., there is no danger of material damage to the rails by the method suggested. Of course, an occasional exceptionally thick tie should be laid aside by the front gang and bedded in by the back gang. The track should also be surfaced as soon as possible after it is laid. Tracklaying machines do not work as well on curves as on straight track, and I would not recommend them for work on very crooked or very hilly roads. Nor is it advisable to adopt the Harris system for less than 100 miles, or the Holman for less than 50 miles of work. The following is an approximate estimate of force and expense in laying track at the rate of two miles per day by the old style iron car method:

1 general foreman,	$5		$5
5 assistant foremen,	3		15
160 laborers,	2		320
22 teams hauling ties,	4		88
1 team hauling iron cars,	4		4
1 engine and train crew,	20		20
Total for two miles			$452

Of course the expense in all methods will vary in accordance with the rate of wages allowed to employees and each method must have sufficient force to work it to its maximum capacity in order to attain the best results.

As to the questions raised in regard to half-tieing and to work on curves and hilly work, we have already expressed our views in favor of full-tieing, and the evidence from other roads seems to indicate that the machines are adapted for work in rough country, with sharp curves and steep grades.

The special feature of steam tracklaying machines is that the ties and rails are run to the front by rollers on tramways operated by steam power. In the Roberts machine there is a series of tramways, with live rollers extending along each side of the train. These tramways are in sections about 32 ft. long, the alternate rollers being driven by a shaft extending the whole length of the train and fitted with universal couplings so as to allow for the motion and curvature of the train. The two shafts on the front or pioneer car are driven by gearing by a vertical engine near the front of the car, and having powerful friction clutches, which will give, and so prevent fracture in case of any obstruction stopping the shaft. This engine is supplied with steam from the locomotive. The rails are sent down on one side of the train, and the ties on the other, the ties being delivered about 60 ft. ahead of the car, so that the tie gang is out of the way of the rail gang. The rollers of each tramway can be operated separately or together. The live rollers of the tie tramway have corrugated surfaces so as to bite the tie and force it along, the intermediate rollers being dead rollers about 1 in. below the live ones. The end chute of the rail tramway projects about 6 ft. beyond the car, so that the bolting up of the heel joints is not interfered with by the car. The tramways are carried by brackets inserted from the bottom of the stake pockets of ordinary cars, so that ties projecting beyond the edge of the car do not interfere with the tramways. The rail cars are placed in front of, and the tie cars behind, the locomotive, and brakes are partly set on the front and rear cars, so as to take up the slack of the train. A small whistle on the stationary engine serves as a signal to the man on the locomotive.

Only a small portion of the front part of the pilot car is occupied by machinery. On the extreme front are laid splice bars and bolts within easy reach of the strappers or bolters, while the rear part is used for tool boxes, track tools, and short rails. Seven men are employed on the train, as follows: 4 men behind the engine loading ties into one tramway, 2 men loading rails into the other tramway, and 1 man at the stationary engine.

These machines were used on the Northern Pacific R. R. in 1890, where the work was obstructed by bridges, etc., so that they could not be worked continuously forward, and they averaged from 4,000 to 5,000 ft. as a half-day's work, while a rate of 9,000 ft. in six hours was frequently made with 28 to 32 men with the train. They have also been used on a number of other roads, mainly in the far West, but below is given a report of operation on a road in Illinois at the present time. These machines are leased to contractors by the Roberts Steam Tracklayer Co., of Seattle, Wash.

The Roberts steam tracklaying machine is now in use on the Chicago, Paducah & Memphis R. R., between St. Elmo and Mount Vernon, Ill., which work is expected to be completed in January. Mr. F. P. Read, Chief Engineer, states that the average speed is two miles per day, and the record-breaking time is one mile in 2 hrs. 50 mins. The rails weigh 60 lbs. per yd., and there are 2,815 ties per mile. The train is made up with the pioneer car (having a small engine supplied with steam from the locomotive) and five cars of rails in front of the locomotive and twelve cars of ties behind the locomotive. These supplies are for half a day's tracklaying. There are 80 men required to lay and finish two miles of track per day. The gang with the train operate the machine, take all material from the cars, put it in place, and full tie, half bolt, and quarter-spike the track. The gang following the train complete the work. The distribution is as follows:

Tracklaying Gangs with Roberts' Machine; C., P. & M. R. R.

36 Men with the Train.	44 Men Behind Train.
3 Foremen	4 Men distributing splices and spikes
1 Engineman on machine	4 Back strappers
4 Men loading ties on trams	16 Back spikers
2 Men loading rails on trams	8 Back nippers
7 Men placing rails	1 Oiler
8 " placing ties	5 Lining track
4 Head spikers	6 Spacing ties
3 Head nippers	
3 Head strappers	
1 Tie liner	

SOME RECENT FENDERS FOR STREET CARS.

The number of fenders for electric and cable cars now in use is surprisingly large, and hardly a day passes that the newspapers do not record the test of some new device of this kind by one of our various street railway lines. In our issue of March 8, 1894, we illustrated and described a number of the more prominent of the fenders in use at that time, and discussed at some length the question of the best method of increasing the safety from collision with cable and electric cars. Since that time much has been done in some of the larger cities in the way of investigation, and a number of new fenders have been developed which promise, at least, that one would stand a much better chance of saving life or limb if ran into by a car equipped with one of them, than if the car was not so equipped, even though they do not insure safety from injury. A number of these latest fenders are described in the following paragraphs:

Fig. 1 shows the Blakistone fender, used on the Central Ry. Co.'s lines, in Baltimore, Md., and the invention of Mr. Geo. Blakistone, President of the company. The device consists of a projecting scoop fender and a supplementary wheel guard. In operation the scoop fender runs about 6 ins. above the track at its front edge, which, as well as the netting, it will be noticed, is of rope. The wheel guard is normally fastened about 8 ins. above the track and can be dropped so that the front edge presses hard against the ground. This wheel guard may be dropped into position to catch a body by any of three separate and independent means, viz.: (1) by the motorman's foot lever; (2) by the rising of the front edge of the scoop 1½ ins. when a body passes under it, and (3) by such a body striking the automatic trip shown suspended just back of the scoop. This trip is shown as a board in the illustration, but, of course, it may be a light metal framework, if desired. Either the scoop or trip can be locked, so as not to act on the guard, which is sometimes necessary, in case of sudden drifts of snow which will catch the trip. The principle of operation is readily seen—i. e., if the scoop fails to catch the person, there yet remains the wheel guard to do so. The special feature of the wheel guard is that it picks up the object and does not push it along over the stones, as do most of the wheel guards in use. In this connection Mr. Blakistone writes us:

Fig. 1. Blakistone Combination Fender, Central Ry. Co., Baltimore, Md.

> I may add that while I designed the front projecting fender at the same time that I designed the wheel guard, I have only put it in use to meet the requirements of our Fender Commission, which demands both the wheel guard and the projecting fender (Eng. News, Sept. 27, 1894). My own views on the subject are, to keep everything off the front of the car, and have an effective wheel guard. Having in a year's service found the wheel guard fender alone entirely sufficient, I should not, of my own choice, put on a projecting fender. For those, however, who believe in a projecting fender, I think mine is about as good as any in use. It, at least, minimizes objections.

Fig. 2 shows the projecting platform fender used on the line of the Buffalo Ry. Co., in the city of Buffalo, N. Y. The construction is simple and is clearly shown by the drawing. This device is stated to have given satisfaction in operation.

Fig. 3 shows the Dubois fender, adopted on some cars of the Toronto, Ont., Electric Ry. As shown by the illustration, the device consists simply of a netting attached to the car platform, hinged at the rear so as to fold up against the front of the car, when not in use. The fender is put in operation by the motorman by a foot lever. The most novel feature is an arrangement by which the current is switched off the motor as the fender falls into position. This fender is the invention of Mr. Lewis E. Dubois, of Toronto, Ont., who writes us that it has already saved a number of persons from injury, if not from death. One of these collisions is described by the Toronto "Empire," of Dec. 1, 1894, as follows:

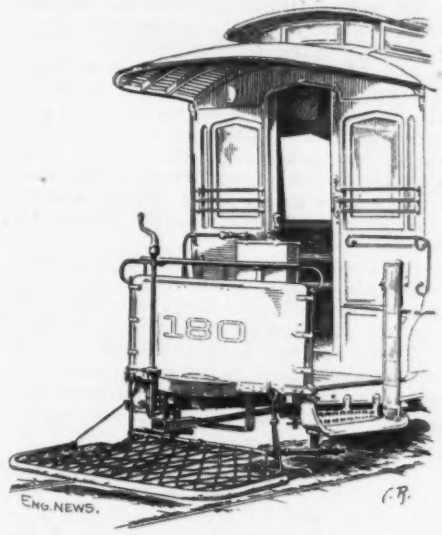


Fig. 2. Platform Fender, Buffalo Ry. Co., Buffalo, N. Y.

Fig. 3. Dubois Fender, Toronto Ry. Co., Toronto, Can.

> The practical utility of the Dubois fender for trolley cars was illustrated in a very remarkable manner by an accident which occurred yesterday. About 10 minutes past 12 o'clock a bicyclist going west ran into another cyclist going east, at the corner of King and Sherbourne Sts. Both riders, who had been speeding along, were thrown from their machines. Just at this moment car No. 474, which is fitted with a Dubois fender, turned down from Sherbourne St., and the fender caught up bicycles and riders, carrying them a distance of about 30 ft. before the car could be stopped. It was then ascertained that the men had escaped without a scratch. One of the two remounted and rode away from the spot before his name could be obtained.

Fig. 4 is a view of the Positive fender attached to a car of the Brooklyn City & Newtown R. R., in Brooklyn, N. Y. The view shows the fender in operation. Normally, the scoop is shoved partly back underneath the platform, and is set in operation by the impact of an object striking its front edge. The motorman can also put the scoop in operation by means of a foot lever. It is possible also to draw the scoop entirely underneath the platform, when it is not needed for use. Several tests have been made with dummies and all of them are stated to have been successful. This device is the joint invention of Mr. Wm. J. McKelvey and Robert Raphael, of Brooklyn, N. Y., and is sold by the Positive Car Fender Co., of that city.

Fig. 4. Positive Fender, Brooklyn City & Newtown R. R., Brooklyn, N.Y.

The illustrations leave little to say regarding the construction and appearance of the several fenders described here. In regard to their operation, it can only be said that they are all in actual use on cars in daily operation, and have proved reasonably effective wherever called into operation. For a more general discussion of the subject, reference may be made to our issue of March 3, 1894.

PORTLAND CEMENT PAVEMENT.

By G. W. Bartholomew, Jr., Treas., Buckeye Portland Cement Co.

The use of Portland cement pavements for sidewalks and streets is becoming quite extensive in many of our middle Western cities. Chicago, St. Paul, Minneapolis, St. Louis, Detroit and Grand Rapids already have a considerable amount of cement walks and driveways, and the mileage is rapidly increasing. The city of Chicago alone has 440 miles of from 6 to 18 ft. cement sidewalk, 107 miles of which were built in 1893, and the city engineer has stated that these walks have proved very acceptable. A correspondent writes from St. Louis that cement pavement is coming to be very extensively used in that city. Minneapolis has nearly 200 miles of cement walks and 3 miles of cement curb and gutter, and St. Paul has about 700,000

sq. ft. of walks and 500 lin. ft. of driveway. Memphis, Tenn., and Terre Haute, Ind., have each over 500,000 sq. ft. of cement walk; and Grand Rapids, Mich., has 1,000,000 sq. ft.; Detroit, 186,000 sq. ft. of cement street pavement, and Dayton, Ohio, 10 miles of cement walks, and many towns of less importance have smaller quantities.

The method of constructing cement pavement, of course, varies somewhat in different cities and for different conditions. A description of its construction in the town of Bellefontaine, O., where considerable attention has been given to securing a method which would give the best results, will, however, give a very fair idea of the usual method adopted.

The street is first excavated to a depth of 6 ins. below the grade line and thoroughly rolled to the proper section. Subdrains of 4-in. tile are then laid inside each curb line. The pavement is laid in two layers. The first layer is 4 ins. thick, and consists of 1 part Buckeye Portland cement and 4 parts clean gravel or broken stone and sand, the ratio of gravel or stone to sand being about 2 to 1. These materials are thoroughly mixed by machine and wetted sufficiently for the water to show at the top when compactly rammed. The second layer or top coating to take the wear is composed of equal parts of Buckeye Portland cement and clean sharp sand, or crushed granite, including all grains up to the size of a pea. Buckeye Portland cement is used entirely at Bellefontaine, and in any case only a cement which will show a strength of 300 lbs. per sq. in. in one month, when mixed densely in the proportions 1 of cement to 3 of coarse sand or crushed stone specified above, should be used. The top coating is thoroughly rammed.

Both the bottom and top layers are divided during construction into rectangular blocks, about 5 ft. square, with their edges neatly finished. The joints of the blocks coming directly over the pipes in the street are made like the keystone of an arch, so that these blocks can be lifted out and the pipes got at without disturbing the neighboring blocks. The advantage of this construction needs no demonstration. To secure a foothold for horses where the grade makes it necessary, the surface is grooved with V-shaped grooves, 1 in. wide and 3-16 in. deep at the middle, running at right angles to each other, and 4 ins. apart. The surface should be finished by an ordinary plasterer's wooden float. The curbs are made of 1 part cement and 3 parts sand, and are a part of the outer blocks of the pavement. The materials required to make 1 sq. yd of pavement, as described above, are 144 lbs. of cement and 4 cu. ft. of gravel, and any ordinarily intelligent workman used to making concrete can do the work.

The smooth, even surface of cement pavement constructed in the above manner places it a little below asphalt in resistance to traction and a little above it in cleanliness, owing to the fact that water in any quantity does not affect the cement, while it causes asphalt to disintegrate. Except to remove articles too large to go into the sewer, no work is required to clean cement pavement except to wash it with a hose. Naturally, since the pavement is so easily kept clean, it is a very healthy one. The Board of Health of the city of Philadelphia considered this to be so much in its favor that it has adopted cement pavements for all courts and alleys in that city. Notwithstanding its smooth surface, however, cement pavement furnishes a good foothold for horses, much superior to asphalt when wet.

Cement pavement is probably fully as durable as granite block, if we may judge from the fact that it shows practically no wear where used for street crossings and in other similar positions for from 20 to 30 years. Cement walk which has been laid six years in Detroit, shows only five or six worn places requiring perhaps half a day's work for one man to repair, in a total of 186,000 sq. ft. In Bellefontaine, where it has been in use on the main street under a heavy traffic, there is scarcely a perceptible sign of wear.

In respect to first cost, cement pavement for streets is much cheaper than stone block, brick, or asphalt, taking into consideration the character of the foundation. At Bellefontaine, O., the cement pavement cost $2.15 per sq. yd, including filling drains and curbs. The cost of maintenance is very small, as any ordinary workman is competent to repair any damages likely to occur. Moreover, in opening the street for pipes, no serious damage is done to the pavement, since the blocks are removed whole and laid back in their original position, leaving the street as perfect as it was before.

THE LATEST DECISION IN AIR-BRAKE PATENT LITIGATION.

In our issue of Oct. 25 we announced the final result of the suit, which has been pending several years, of the Westinghouse Air-Brake Co. vs. The New York Air-Brake Co., for infringement of patents on the quick-action triple valve. It will be remembered that the outcome of this suit was a permanent injunction forbidding the New York Air-Brake Co. from making and marketing either of the two triple-valves which it first placed upon the market, and ordering an accounting and the payment of damages to the Westinghouse Co. for past infringement.

These valves had been withdrawn from the market some months before by the New York Co., by reason of a preliminary injunction issued after the trial of the case in the lower court; and in their stead a valve has been offered by it on the market, which has been claimed to avoid infringement of the Westinghouse patents. To quote from a letter of the New York Air-Brake Co. to this journal, in our issue of Nov. 15 (p. 411):

> The result to any fair-minded and intelligent person conversant with air-brakes of a careful reading of the Court of Appeals decision will be to convince him that the present valve of the New York Air Brake Co. is absolutely free from any of the patents which were involved in the case just decided by the Court of Appeals, and that the New York Air Brake Co. is free to make it and the railways to use it.

We suggested, in a note appended to this letter, that the question whether this latest New York valve infringes the Westinghouse patents was a matter which the public would know more about after the new suit which the Westinghouse Co. brought concerning this valve had come to trial and been decided. We did not then apprehend, however, so early action on this case by the courts. Suit on this valve was brought some months ago, and on Dec. 14 a motion was argued before Judge Lacombe, in the United States Circuit Court, in which the attorneys for the Westinghouse Co. asked for a preliminary injunction restraining the New York Co. from making and selling this latest form of valve, pending the trial and final decision of the case. On Dec. 27 a decision was handed down by the court granting the preliminary injunction asked for.

In his decision Judge Lacombe first takes up the Westinghouse patents 360,070 and 376,837, and shows that, according to the recent decisions by Judges Townsend and Shipman, these are broad patents and their claims must be given a liberal interpretation. To quote the language of Judge Lacombe:

> Both these patents, 360,070 and 376,837, are broad ones, and their claims should be construed to cover the meritorious invention they disclose, unless the language of such claims precludes such a construction. The only question really open on this motion is that of infringement.

He then takes up the question whether this latest valve of the New York Co. does infringe, and it is of interest to note how the New York Co. proposed to evade the Westinghouse patent. Claim 1 of Westinghouse patent 360,070 is for a certain combination, in which is included "an auxiliary valve device, actuated by the piston of the triple-valve." In the drawings of the patent the piston of the triple-valve "actuates" the stem of the auxiliary valve device by direct impingement upon it. The New York valve contains the same combination as that in Claim 1 above, except that the "auxiliary valve device" is not moved directly by the triple-valve. Instead the triple-valve opens a port which reduces pressure on one side of another piston in a supplemental chamber, and the movement of this piston opens the emergency valve. It will be seen, then, that the question whether the New York valve infringed the above claim or not turned upon the scope given to the word "actuated." Concerning this, Judge Lacombe says, in his decision:

> None the less is the auxiliary valve device "actuated" by the piston of the triple-valve, though two pistons do the work of one, and the action of the triple-valve piston is indirect instead of direct. Such an addition to the mechanical details of the combination is within the doctrine of equivalents, when the original invention is a broad one, as this undoubtedly is, and the language of the claim fairly covers it, which is the case here, the word "actuated" being applicable equally to indirect and to direct actuation. Nor will it avail defendants as against the claim of a broad patent that the addition to the mechanism is itself an advance in the art—an advance, it may be noted, which is not theirs, but one they have appropriated from a subsequent patent of the same inventor. The person who discovered the advantage of a supplemental motor for the emergency valve and devised its mechanism was, as the Court of Appeals has held, entitled to a broad patent for that highly meritorious invention, which was essential to complete success in the art, but that circumstance did not entitle him to appropriate the meritorious and equally essential emergency valve of the earlier patent, so long at least as he actuated his supplemental motor in the way in which such earlier patent claimed, viz.: by the piston of the triple-valve.

Continuing, the decision declares that the valve infringes also claims 2 and 4 of No. 360,070, and then takes up the question of the infringement of No. 376,837. In the letter of the New York Co. to this journal, quoted from above, it was stated that the New York Co. would base its claim of non-infringement on the ground that the piston of its emergency valve was not "actuated by pressure from an auxiliary reservoir," which is the language of the claim in the Westinghouse patent 376,837. In his decision, Judge Lacombe describes the emergency valve piston of the New York Co., and discusses it as follows:

> The supplemental piston Q when at rest is pressed upon from below by train-pipe pressure. It remains at rest because the space between its face and the enclosing walls of the chamber in which it moves is filled with air of like pressure which reaches such space from the train-pipe through two narrow conduits, p and u, and a connection, t. When the device is actuated upon the excess stroke of the triple-valve piston, the connection t is moved, the conduit p is, for an instant, closed and then opened to the outer air. Thereupon the space above the piston is voided of compressed air and the train-pipe pressure from below, being no longer counterbalanced by pressure in the chamber above, moves and unseats the valve. It is actuated therefore by the withdrawal of the air pressure from the chamber above, which, before it is thrown open to admit of such withdrawal, has been cut off from all connection with the train-pipe. Pressure from the auxiliary reservoir at no time operates upon it either to hold it at rest or to put it in motion. Defendant contends that the claim of the patent must be restricted so as to cover only supplemental devices which are actuated by pressure from the auxiliary reservoir, and therefore that its present device does not infringe. The phrases "train-pipe pressure" and "auxiliary reservoir pressure" had, prior to the granting of this patent, acquired a well-known meaning in the art, and the use of one in a claim could hardly be construed to mean the other. But complainant contends that the phrase used in this claim to describe the means for imparting motion to the supplemental piston is not "actuated by auxiliary reservoir pressure" nor "actuated by pressures from THE auxiliary reservoir," but "actuated by pressure from AN auxiliary reservoir." If some one should reproduce every detail of the claim with the single exception of adding a separate and additional chamber or reservoir, which was charged from the auxiliary reservoir and then cut off from it, and should use the force thus stored in that additional or supplementary chamber or reservoir for the sole purpose of imparting motion to the supplemental piston, his device would, within the ordinary use of words, contain the element of actuation "by pressure from an auxiliary reservoir" whether the additional chamber were contained as a sub-reservoir within the auxiliary reservoir proper or was placed entirely outside of the latter. The charging of such additional reservoir, not from the auxiliary reservoir, but in the same way as the auxiliary reservoir itself is charged, viz., by admitting train-pipe pressure into it through a charging port and then cutting off connection with the train-pipe, does not seem to involve any substantial difference. And where the patent is a broad one, as this is, with a full range of equivalents, the maker of such a device may fairly be held an infringer. Whether the device of the defendant contains such an additional auxiliary reservoir in the chamber P above the piston face is the question in dispute. For the brief moment when, after being charged, it is cut off from the train-pipe, it seems to be such, and the compressed air which it contains to be within a broad definition of "auxiliary reservoir pressure," viz., air compressed at the locomotive, and which, passing through the train-pipe, has got beyond a charging port which thereafter cuts off its connection with the source of supply, and detains it as stored-up pressure to be used in an emergency.

In view of the broad construction given to 376,83[illegible] by the Court of Appeals, the defendant's device must

be held to infringe this claim. Infringement of the third and fourth claims is not so clear and those questions must be reserved for final hearing.

ANNUAL REPORT OF THE PULLMAN PALACE CAR COMPANY.

With the last annual report to the stockholders of the Pullman Palace Car Company, covering the fiscal year ending July 31, 1894, is a financial statement for the past 27 years, showing the remarkable growth of this corporation. The company was organized in 1867, with a capital of $1,250,000. The first year's report showed assets of $1,470,850 and a gross revenue of $258,000, against gross expenses of $88,293. Within six years the assets had increased to $10,841,917, with $2,994,407 gross revenue and $1,141,277 gross expenses. Then for five years there was a gradual decline, but in 1878 affairs took an upward turn, and in 1893 the company reported a gross revenue of $11,389,986. During this 27 years the stock was increased 16 times, and in 1893 the company paid 18% on $36,000,000 of capital stock at par; and in 1894, with $2,000,000 less gross receipts than the year before, it paid 14%. The net revenue for the 27 years was $60,405,700, and of this $28,192,887 was paid out in dividends and a net surplus of $26,042,006 has been accumulated. For the last five years the profits have averaged over $5,000,000 per annum.

The report for the last fiscal year shows that the company owns or controls 2,588 cars, which carried 5,282,323 passengers, over a total mileage of 197,409,503 miles. These cars are operated over 126,411 miles of railway. The company employs 10,858 persons and paid out for the year $4,968,548 in wages. During the year the company built 15 parlor and 6 dining cars, at a cost of $347,947.

The financial statement for the last year shows revenue, disbursements and assets as follows:

From earnings of cars	$8,761,935
From patents owned	6,386
From patents, dividends, interest, etc.	826,726
Total revenue	$9,595,067
Operating expenses	$3,497,298
Paid other sleeping car companies	897,352
Dividends on capital stock	2,880,000
Total disbursements	$7,274,650
Surplus for year	2,320,417

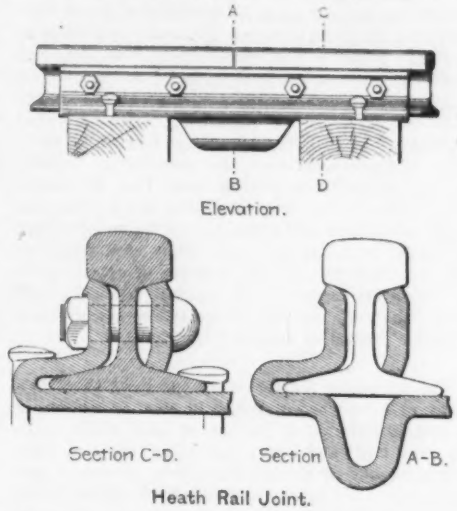
The assets, condensed from the statement, are as follows:

1,650 cars, equipments and franchises	$24,248,793
Investment in other sleeping car companies	5,273,331
Real estate, plant, houses, etc., at Pullman	7,500,414
Materials of construc'n and operat'g supplies	3,672,163
Other real estate, plant, furniture, etc.	2,019,090
Bonds and other securities	7,242,195
Accounts receivable and payable	10,773,148
Total assets	$62,042,606

TWO RAIL JOINTS WITH BASE SUPPORT.

We have frequently pointed out that in the design of new rail joints an increasing tendency is evident toward supplementing the splice members of the joint by a base support, to prevent the deflection of the rail ends. Several forms of joints embodying this principle of construction, have been described and illustrated in our columns. Herewith we present two other joints of this type, both of which are in extensive use and have been favorably reported upon by individual roadmasters and in the reports of the roadmasters' associations.

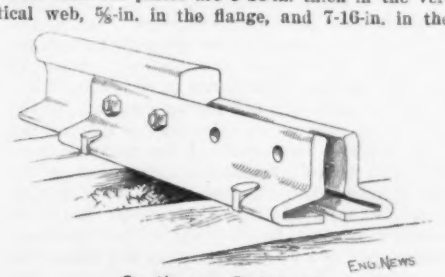
The Heath rail joint consists of a plate, 11×24 ins. and ⅝-in. thick, bent to form an angle bar and base plate, extending under the full width of the rail base, the ends of the plate resting upon the joint ties, while the middle of the plate is dished so as to form a pocket, which stiffens the joint under the rail ends. On the inner side of the rail is a plain splice bar or fish plate, and four ordinary track bolts pass through the bars and rails. Spikes are driven through the inner side of the base plate, to prevent creeping. The combined angle bar and base plate is made of ⅜-in. tank steel, of low carbon (0.1%), and is heated in oil ready for being shaped under a steam hammer and then punched for the bolts, a double punching machine being used. This joint is manufactured by the Heath Rail Joint Co., of Minneapolis, Minn., whose new works, at Chicago Heights, Ill., have furnace capacity for heating 3,000 plates per day of ten hours, and can turn out from 1,500 to 2,000 joints per day. The heat from the oil heating furnaces is carried under the boiler and utilized in making steam to run the machinery, which includes one 10-HP. and three 20-HP. steam hammers, a 20-HP. double-shearing machine, and a double punching machine. The joint has been applied, with satisfactory results, to



Heath Rail Joint.

old rails, and is in use on over 50 railways, including 150 miles on the Atchison, Topeka & Santa Fe Ry. and 56 miles on the Chicago, Peoria & St. Louis Ry. The cost is said to be from 57 cts. to $1.15, according to size of rail.

The Continuous rail joint consists of two angle bars, with wide flanges bent round to fit under the rail, and form the base support, each plate extending under approximately half the width of the rail base. The ends of the plates rest upon the joint ties, and the edges are slotted for the spikes. For 67-lb. rails the plates are 9-16-in. thick in the vertical web, ⅝-in. in the flange, and 7-16-in. in the



Continuous Rail Joint.

base. The bars are made of low carbon (0.1%) steel. They made be made of any desired length and are secured by four or six ordinary track bolts, but short bars and four bolts are preferred. This joint is in use on some 50 railways, and has been used on old and new rails, while it has also been used to stiffen and strengthen rails at points where interlocking apparatus has made it necessary to place ties 4 ft. apart. It is extensively used by the Boston & Maine R. R., on the new standard 75-lb. rail, as well as on old 72-lb. rails, in which latter case it is found to materially reduce the cost of surfacing. This joint is manufactured by the Continuous Rail Joint Co., of Newark, N. J.

KOSMOCRETE CONCRETE SIDEWALKS.

The use of cement concrete sidewalks is rapidly becoming popular and one special system is the Kosmocrete pavement, of which some 200,000 sq. yds. have been laid in Brooklyn, N. Y., in addition to considerable amounts in other cities. A bottom course of dry cinders, about 12 ins. thick, is laid, and upon this is a layer of concrete about 4 ins. thick, composed of 3 parts of granulated granite or sharp gravel, 4 parts of 1½-in. stone and 1 part Portland cement. On this concrete is worked a facing about 1 in. thick, composed of granulated granite, a small percentage of silicious grit, Portland cemen and carbon. The purpose of the granulated granite mixed with silicious grit is to prevent the surface from becoming slippery. This concrete is used not only for sidewalks, but for stable flooring and the paving of public buildings, including the armories of the 23d and 14th regiments in Brooklyn. It is also used for making sewer pipe. It has been in use at the New York Custom House for about four years, and is to be used in the new terminal stations of the Brooklyn Bridge. The cost ranges from 25 to 35 cts. per sq. ft., depending largely upon the distance the material has to be hauled and the amount of work that has to be done preliminary to laying the pavement. The concrete has been used experimentally for street paving, one section having been laid with it at 20th St. and Greenwood Cemetery, Brooklyn, and being in fair condition after about six years' service under heavy traffic. In this case the concrete is about 6 ins. thick, and at the middle of the street the surface is divided into rectangular blocks by deep grooves. For such work, however, it is necessary that the street should be closed for traffic for a sufficiently long time to allow the concrete to become thoroughly set and hard. The Kosmocrete pavement is manufactured and laid by the Wilson & Baillie Mfg. Co., of Brooklyn, N. Y.

EXPRESS LOCOMOTIVE, PENNSYLVANIA R. R.

The latest design of passenger engine brought out by the Pennsylvania R. R. is of the eight-wheel type, with driving wheels 6 ft. 8 ins. diameter, and is known as Class P. These engines are designed for hauling the heavy express trains on the New York division principally, but are also used on other divisions where similar service is required. The engines are equipped with truck and driver brakes, and are intended to burn either bituminous coal or anthracite. We are indebted to Mr. Theodore N. Ely, Chief of Motive Power, for the following list of dimensions (given in our standard form), and shall publish drawings in a later issue:

Running Gear.—Driving wheels, diam.	6 ft. 8 ins.
Truck wheels, diam.	3 " 0 "
Tender " "	3 " 0 "
Tender " "	3 "
Engine truck	Rigid center
Journals, driving axles	8½ × 10½ ins.
" truck axles	5½ × 10 "
" tender "	4 × 8 "
Wheel Base.—Driving	7 ft. 9 ins.
Truck	6 " 7 "
Total engine	22 " 9¼ "
" tender	16 " 1 in.
" engine and tender	49 " 3¼ ins.
Center of truck pin to center of leading driver	11 " 9 "
Driving wheels having blind tires	None
Weight in working order; on drivers	87,300 lbs.
On truck wheels	39,750 "
Engine, total	127,050 "
Tender, "	70,000 "
Engine and tender, loaded	197,050 "
Tender, empty	30,100 "
Of full coal capacity	15,000 "
Of full water capacity of tank..3,000 galls.	24,000 "
Allowed for water in boiler	16,500 "
Cylinders	19 × 24 ins.
Distance center to center	6 ft. 5 "
" center to valve face	1 ft. 5 9-16 "
Piston rod, diam.	3 "
Form of crosshead and guides	Three-bar guides
Connecting rod, length between centers	7 ft. 10¾ ins.
Valve Gear.—Type	Shifting link
Ports: length, 20 ins.; width steam, 1¼ ins.; width exhaust	3 ins.
Slide valves: lap, 1⅛ ins.; max. travel, 6 ins.; lead, none.	
Boiler.—Type	Straight top
Diam. of barrel inside	4 ft. 9 ins.
Thickness of barrel plates	7-16 in.
Thickness of smokebox tube plate	½ "
Height from rail to center line	8 ft. 4 ins.
Length of smokebox (including extension front end)	5 " 11 "
Working steam pressure	175 lbs.
Firebox.—Type	Belpaire
Length inside	9 ft. 11¾ ins.
Width inside	3 " 4 "
Depth at front	5 " 0⅛ in.
Depth at back	3 " 10½ ins.
Thickness of side and back plates	5-16 in.
" crown sheet	⅜ "
" tube sheet	⅜ "
Grate area	33½ sq. ft.
Staybolts: diam., ¾ in.; pitch (approximate), 4⅜ ins.	
Water space, width, front, back and sides	4 ins.
Fuel	Anthracite or bituminous coal
Tubes...Material, wrought iron; No., 238; pitch (approx.)	2⅛ ins.
Diam. inside, 1⅝ ins.; outside	1⅞ "
Length between tube plates	11 ft. 4 ins.
Total fire area of tube openings	3.92 sq. ft.
Heating Surface.—Ratio to grate area	47.6
Ratio of exterior tube area to firebox heating surface	9.7
Tubes, exterior, 1,435 sq. ft.; interior	1,244 sq. ft.
Firebox	148 "
Total with exterior tube area	1,583 "
Total with interior tube area	1,392 "
Miscellaneous.—Exhaust nozzle, diam.	5¼ ins.
Smokestack, smallest diam.	1 ft. 1½ "
Smokestack, height from rail to top	15 ft.
Capacity of tank	3,000 gallons
Capacity of coal space	15,000 lbs.
Brake fittings: P. R. R. brake on driving wheels; American brake on truck.	
Tractive force per lb. effective press. on piston	1,083 lbs.
Total tractive force with effect. press. = 4-5 of boiler pressure	15,162 lbs.
Total adhesive tractive power, at ¼ of weight on drivers	21,825 "

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With this number of Engineering News a change is made in the arrangement of the departments of the paper, and a few words of explanation as to its objects will be of interest. As stated in our last issue, the increase in the quantity of matter in our "Construction News" department is to be maintained during the coming year, and every endeavor will be used to completely cover the field and to make this journal more than ever a reliable and indispensable aid to contractors, engineers and firms dealing in all classes of engineering supplies. For the convenience of our readers, it has been decided to separate the "Construction News" pages and to print them, together with the personal items, the news of engineering societies and the brief notices of new publications and trade catalogues in an eight-page supplement, which can be readily removed from the remainder of the paper for greater facility in use.

While the convenience of the contractors, supplymen, engineers, etc., who make regular use of this department is thus consulted, we believe that the very large proportion of our readers who regularly preserve and bind their volumes, will also welcome the change, as the 8-page supplement, the contents of which are for the most part of current interest only, need not be bound up with the 16 pages devoted to matter of permanent technical value.

With the transfer of the "Society Proceedings" department to this new position, the reports of meetings held will be condensed, so as to give only a statement of the business done at the meetings, with the titles of papers read, and only so much concerning them as will enable the reader to judge of their nature and decide whether their value to him is sufficient to warrant him in obtaining them. Where papers or discussions before a society contain information of such value as to demand its publication in full or in abstract, it will be presented in the body of the paper, under an appropriate title, where it can be conveniently indexed and referred to when desired. An exception will be made of the reports of the annual conventions of the national engineering societies, which will be presented in the body of the paper, by reason of their greater importance and interest. Reviews of important books will be found, as heretofore, on the pages just preceding the editorial page; but brief notices, containing matter of current interest only, will be found in the supplement. With this brief explanation, it is believed that our readers will find no inconvenience from the new disposition of the matter.

We alluded last week to the valuable work which we believe we are doing for our readers in our Construction News department. Evidence that the news in these pages is appreciated reaches us, not only from our readers, but is to be found in the columns of several of our weekly contemporaries. In our issue of Dec. 20 we published, under the head "Bridges," on p. 521, 18 items of news concerning new bridge construction. An enterprising contemporary, in its issue a week later, Dec. 26, copied every one of these items, changing the wording and condensing them somewhat, but giving no additional facts and omitting many particulars of importance. We feel flattered by such evidence of appreciation, and hope the readers of the journal which displays such talent in the way of imitation are satisfied with the perusal of ancient history.

The drawspan illustrated on our inset sheet this week and described at length in another column, is a notable example of the use of plate-girder work for very large and heavy structures where a truss design would invariably have been chosen a few years ago. We believe this four-track bridge of 176 ft. span is the heaviest plate-girder swing span ever erected. The center girder of this bridge, 176 ft. in length and over 9 ft. deep at the center, must rank with the very heaviest girders ever built. The practical advantages in the use of plate-girders for swing bridges are that the structure exposes a smaller surface to wind pressure and the center of gravity and center of pressure are so low that a given wind pressure has very small overturning moment. It is also easier to handle the bridge in high winds.

We publish elsewhere in this issue two papers on cement or concrete pavements, giving information of considerable interest to engineers. The merits of concrete as a material for sidewalk paving are pretty well known, and under special names, as granolithic paving, Kosmocrete paving, etc., it has the highest reputation as a paving material. In the papers above referred to, an account is given of the use of concrete as a material for roadway pavements, and not as a foundation merely, but for the wearing surface as well. The city of Bellefontaine, O., has had several blocks of this paving in use for a considerable time, and it has given such good satisfaction that two more blocks were laid during the past season. The results obtained with any such paving will, of course, depend very largely on the manner in which the concrete is made and the materials used in it. The evidence presented seems to show that it is possible to make a concrete so strong and durable that it will give satisfaction as a street pavement under a moderate traffic. That it is "probably fully as durable as granite block," as one of our contributors states, is putting the case rather strongly, for no one would expect even the best possible concrete to approach a good granite or trap paving block in resistance to abrasion. One difficulty with its use as a street covering is the necessity of closing the street to traffic for some days, until the cement has thoroughly set. It shares with asphalt the advantage of giving a continuous and impervious covering to the street, and as it can be laid somewhat more cheaply than asphalt, its use for alleys, stables, private driveways, etc., is likely to rapidly extend. Engineers will watch with interest the results of longer experience with it as a material for roadway paving.

The appointment of Col. George E. Waring, Jr., M. Inst. C. E., as Commissioner of Street Cleaning in New York City, insures the services in this important department of a man of marked executive capacity and one aggressive in methods and well posted in the sanitary engineering of cities. The appointment in itself is a wide departure from long established precedent, and is evidence of a purpose on the part of New York's new Mayor to select men for executive positions with regard to their fitness rather than for their political experience and influence. Col. Waring has his enemies among engineers, and these will not be pleased with the appointment, But if we know the man he will recognize the opportunity for making a record by introducing much-needed sanitary reforms, and he will push these reforms with all the energy and executive ability which are undoubtedly his.

Garbage disposal in Chicago seems to be a problem beyond the solution of the city officials, judging from accounts from that city. The garbage is still dumped promiscuously on the surface of the ground in and about the city, as was noted in our issue of Aug. 2, 1894, and left there to putrefy and give offense to all who live in the vicinity or come near it. Perhaps no other city in the country has experimented with more different methods of garbage treatment than Chicago, but still the city goes on scattering its offal about its borders in the same old primitive manner, a method, or, more properly, lack of method, which is a standing disgrace to a city which claims a population above a million and a half. It is true that until recently systems of garbage disposal suited to a large city were in an experimental stage, but to-day, where Philadelphia, New Orleans, Boston, Cincinnati, St. Louis, Milwaukee, Detroit, Montreal, Buffalo, Rochester, Des Moines, Savannah, and a host of smaller cities are leading the way, Chicago ought to be able to follow. If the great city by the lake cannot devise some means for the final disposal of its garbage, possibly it can at least rouse itself to demand that the contracts in force for its garbage collection shall be faithfully carried out. The Civic Federation of the city declares that this is not now being done, and that the city's inspectors are bribed to neglect their duty.

Absolute prohibition of the crossing of steam railway tracks at grade by electric railways is the recommendation of the Connecticut Railroad Commission in its annual report. The recommendation is a wise one and ought to be heeded. A structure sufficiently strong to carry electric cars over a steam road can generally be built at moderate expense, and the separation of grades removes an ever-present danger of accidents.

We show in another column two rail joints which are coming into use to quite an extent, and which illustrate the steady tendency toward a joint giving an elastic support to the base of the rail which, while not heavy enough to act as an anvil, will at least compel the rail ends to deflect uniformly. The object, of course, is to hold the rail ends in practically the same plane, so that the leaving rail will not be depressed below the entering rail as the wheel approaches the joint. In the ordinary joint this often occurs, and the result is a direct blow of the wheel upon the end of the entering rail. It is only a few years ago that the Fisher joint was practically the only representative of the base supporting joint, whereas we have now in service the Delano (C., B. & Q. Ry.), the Churchill (N. & W. R. R.), the Weber, Heath, Long and Continuous joints, while the Price, Niles and other forms are in more or less use experimentally. Any of our readers who travel much on the New York elevated railways will have noticed that the Weber joint is rapidly replacing the six-bolt angle-bar joints. The report presented by the rail joint committee at the annual meeting of the Roadmasters' Association of America, in September last, stated that the bridge type of joint possessed many advantages over the ordinary angle-bar joint, and in the discussion on this report there was evident a strong opinion in favor of a base support, which resulted in the adoption of a resolution to the effect that improved joints should be designed on this principle.

The issuance of an injunction by Judge Lacombe, on Dec. 27, stopping the manufacture and sale of the latest form of quick-action triple-valve put on the market by the New York Air-Brake Co., establishes more fully than ever the validity of the Westinghouse patents, and is so sweeping in its scope that it will probably permanently terminate the various attempts which have been made to manufacture quick-action triple-valves without coming in conflict with these patents. Reviewing briefly the history of this litigation, the New York Co., some four years ago, put two triple-valves on the market, withdrawing the first soon after its intro-

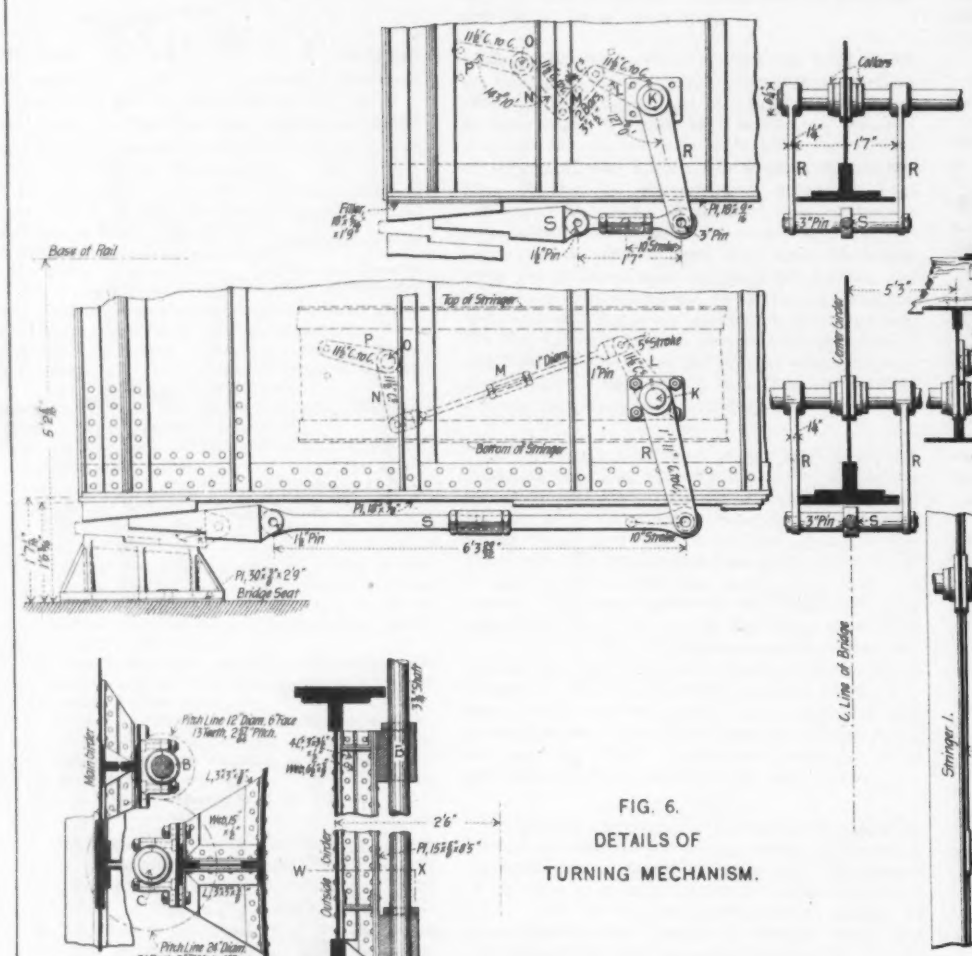


FIG. 6. DETAILS OF TURNING MECHANISM.

FIG. 9. DETAILS OF LOCKING AND RA

FIG. 1. HALF ELEVATION OF MAIN CE

FIG. 3. ELEVATION OF MAIN FLOOR BEAM.

FIG. 2. HALF ELEVATION OF MAIN CROSS GIRDER.

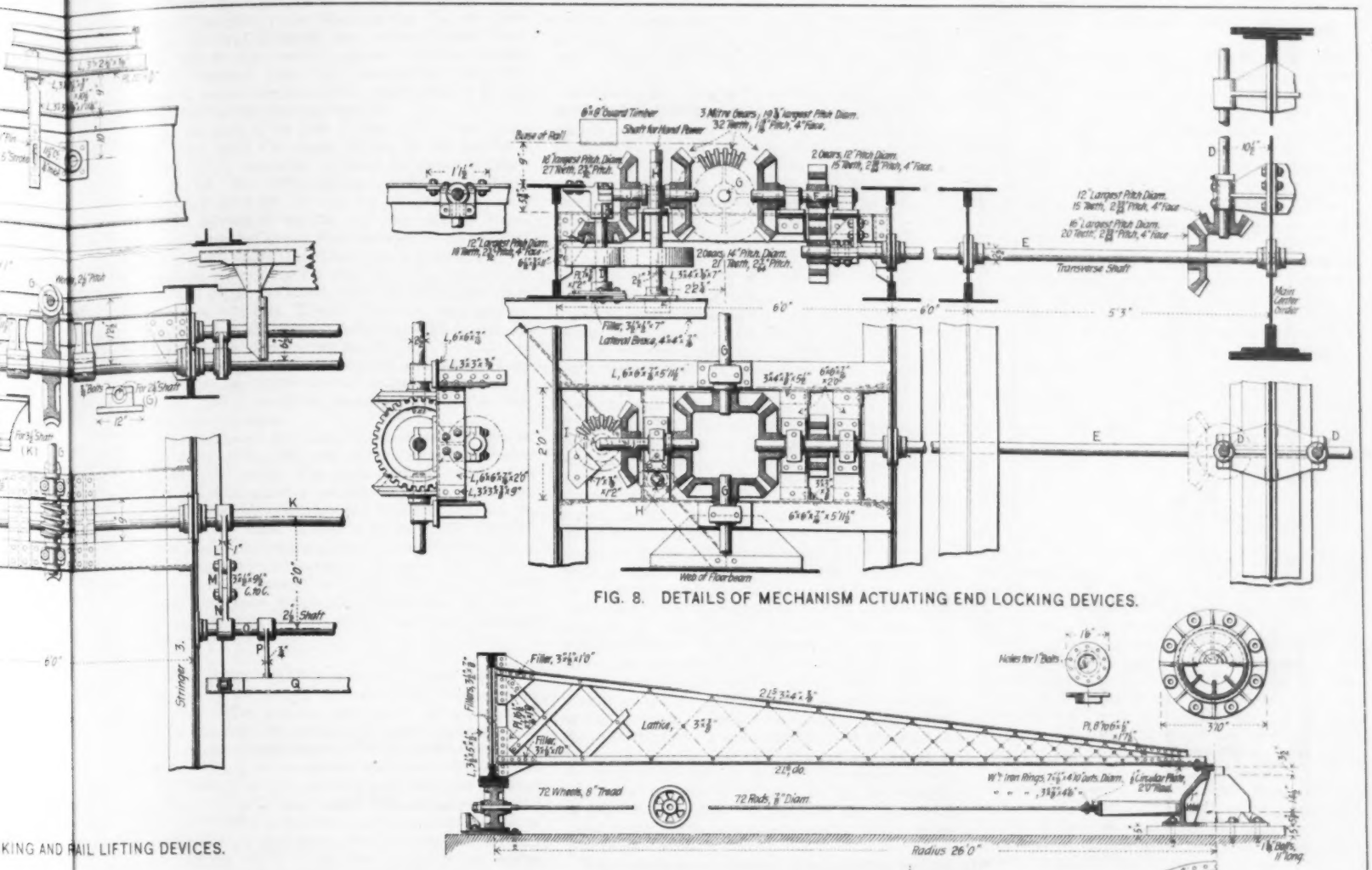

Base of Rail
Shaft for Hand Power
3 Mitre Gears, 19½" Largest Pitch Diam. 32 Teeth, 1⅛" Pitch, 4" Face.
2 Gears, 12" Pitch Diam. 15 Teeth, 2⅛" Pitch, 4" Face.
12" Largest Pitch Diam. 15 Teeth, 2⅛" Pitch, 4" Face
16" Largest Pitch Diam. 20 Teeth, 2⅛" Pitch, 4" Face
Transverse Shaft
Main Center Girder
2 Gears, 14" Pitch Diam. 21 Teeth, 2⅛" Pitch.
Filler, 3½"x⅜"x7" Lateral Brace, 4"x4"x⅜"
Web of Floor beam
Stringer
Shaft
Base of Rail
Pinion, 15" Pitch Diam, 17 Teeth
Main Center Girder

FIG. 8. DETAILS OF MECHANISM ACTUATING END LOCKING DEVICES.

KING AND RAIL LIFTING DEVICES.

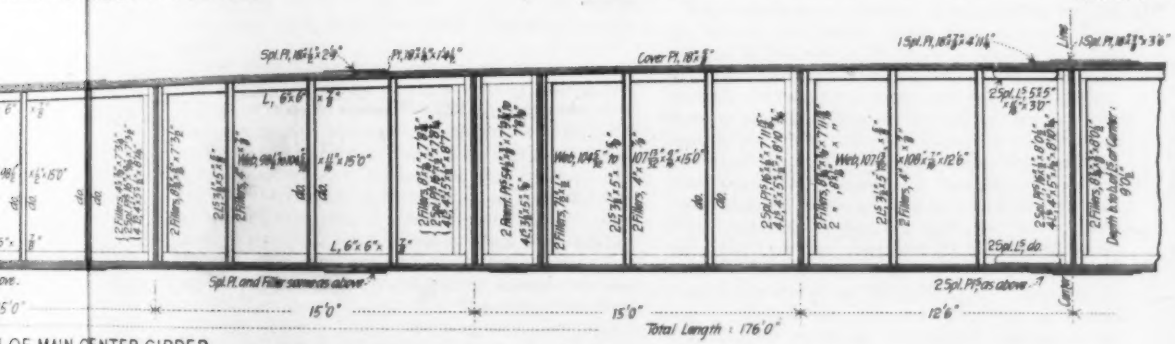
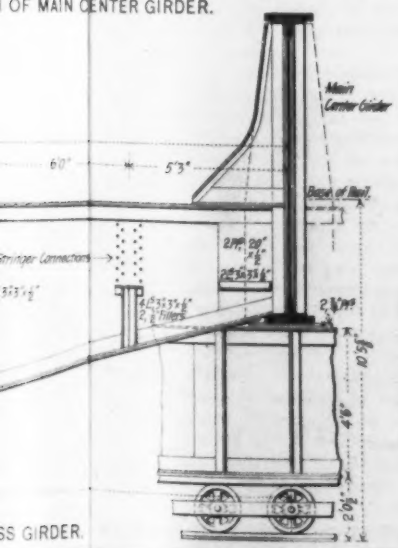


FIG. 4.
DETAILS OF RADIAL TRUSS STIFFENER AND CONNECTIONS FOR DRUM.

OF MAIN CENTER GIRDER.



SS GIRDER.

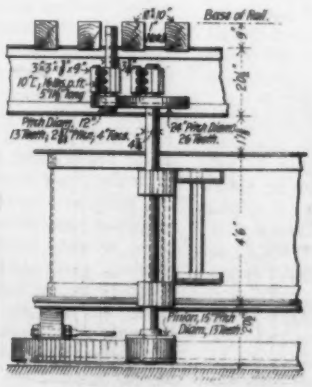


FIG. 7. HAND TURNING DEVICE.

FOUR-TRACK PLATE-GIRDER SWING BRIDGE; NEW YORK, NEW HAVEN & HARTFORD R. R.

F. S. Curtis, M. Am. Soc. C. E., Chief Engineer N. Y., N. H. & H. R. R.
Wm. Harley Moore, Bridge Engineer, N. Y., N. H. & H. R. R.
Passaic Rolling Mill Co., Paterson, N. J., Contractors.

CHAS. HART & SONS, LITH., 90 VESEY ST., N. Y.

duction, on account of its imperfect working. In the suits for infringement of its patents by these valves, brought by the Westinghouse Co., the New York Co. was defeated, first in the Circuit Court and later in the Court of Appeals. It was permanently enjoined from the manufacture of these valves, and a judgment for damages against it was awarded to the Westinghouse Co.

At the time of its first defeat in the lower court the New York Co. began putting on the market a third valve, especially designed to avoid infringement of the Westinghouse patents. It was promptly sued on this by the Westinghouse Co., which, instead of waiting the many months which must elapse before the final decision in the court of last resort, asked the Court for a preliminary injunction restraining the New York Co. from making and using this latest valve while litigation is in progress. On Dec. 27 this injunction was granted, the Court in its decision brushing aside, as trivial evasions, the devices used by the New York Co., in its attempt to avoid infringement, and giving to the Westinghouse fundamental patents so broad a scope that it is difficult to see any chance for their successful evasion.

We discussed the issues involved in this case in our issue of Oct. 25, and will not again take space to consider them. The decision itself is given in substance in another column, and will well repay study by every one interested in patent practice, as well as by those interested in air-brake matters. The important principle, that the courts will protect by preliminary injunction a patentee who has established the validity of his patents by a previous suit, has been frequently illustrated, but never better than in this important and hard-contested litigation.

The subject of safety fenders for street cars is receiving an increasing amount of attention in every city in which electric cars are in operation, and, either through the pressure of public opinion or by the official requirement of city or state officials, the equipment of all street cars with some efficient form of fender is pretty certainly a necessity of the near future. In fact, many cities have already made the use of fenders compulsory, and the common plea of street railway managers, that they are only waiting to find out which is the best fender before equipping their cars, is received with impatience by the public.

But, besides the direct pressure of public opinion, and the natural desire of every railway manager to use every possible means to avoid accidents, the time has now come when mere considerations of financial policy dictate the use of fenders on every street railway. It is cheaper, in the long run, to equip cars with fenders than to leave them off. In the first place, public opinion is now at a point where courts and juries will mulct a company much more heavily for damages in an accident suit, where a person has been run over, if the car doing the damage was not equipped with a fender. The Brooklyn City Railroad Co. recently had a verdict against it of $25,500 for running over and maiming a child, a sum which would go a long way toward equipping all its cars with fenders.

We have before pointed out that the public opinion of the gain in safety secured by even the best fenders is probably a good deal exaggerated. On the other hand, sufficient experiments and experience have now been accumulated to make it certain that the best fenders do greatly diminish the chances of maiming or killing a person struck by a car. By a study of the list published on another page of this issue, and that in our issue of March 8, 1894, it will not be difficult to select the chief points of merit which an efficient fender should possess. It may be noted that the tendency appears to be more and more to rely on a front fender, or catcher, rather than a wheel guard, for safety. The companies have generally preferred the wheel-guards, as being less likely to frequent breakage by collisions, etc., but the risk of injury to a person in being shoved along over the paving by a wheel-guard is very great, even if he escapes injury in passing under the front of the car body. If a wheel-guard fender is to be the sole reliance, however, all projecting rods on the front of the car should be avoided. A notable instance of carelessness in this respect is seen on the Broadway and Third Ave. cable railways, in New York city, on which most of the cars have excellent wheel-guard fenders. A long pin, however, projects down from the front of the car body some 6 ins., and might easily inflict a fatal wound on a person forced under it.

A second feature, to which more attention is being paid by designers of fenders, is the provision of netting in front of the dasher to prevent injuries to a person caught up by the dasher through striking the head against the dasher, brake-shaft, or other apparatus on the front of the car. Reference to the cuts, in another column, will show that three of the fenders there illustrated are designed to afford this protection, and in only one has it been neglected.

TRACKLAYING BY MACHINERY.

Tracklaying by machinery is the subject of an article in another column, and perhaps few engineers, except those familiar with the construction of long lines of railway, understand the extent to which such machines are employed, in order to effect economy in time and in cost of work. They are used mainly in the West and on long lines, but have been used as far East as the Adirondack & St. Lawrence Ry., in New York, and on the Chicago, Paducah & Memphis Ry., in Illinois, the latter road being now under construction. In many cases the outfit is not sold, but leased to the contractors by the owners of the patent, so that under such arrangements the machines are available for work on shorter lines than would be the case if the contractor had to purchase them outright. One make of machine has been used on nearly 60 roads in the West and South. The term tracklaying machine is not strictly correct, and is apt to be misleading to the uninitiated, since the machine does not lay the track, either in the sense of laying the material or in the more general sense of laying, bolting and spiking, all of which work is usually understood to come under the head of tracklaying. Tracklaying by machinery simply means that the material train is kept right up with the head of the track, and that the rails and ties are carried to the front of the train by a system of tramways laid upon or at the side of the cars, so that the material is delivered right into the hands of the tracklaying gang, usually from chutes projecting in front of the first or pilot car.

With the ordinary system of tracklaying the ties are either distributed along the subgrade from wagons, or are run to the front on light cars hauled by horses, but the former method cannot be followed in rough or swampy country, and the latter involves more or less haul between the supply train and the head of the track. The rails and fastenings are run ahead on small cars, the rails being loaded lengthwise, so as to be pulled off conveniently, the car being pushed ahead as fast as the rails are laid. With machine tracklaying, however, the supplies for a day's or half a day's work are carried on the material train and delivered right where wanted, the train being moved up 30 or 60 ft. at a time, according to whether the rails are laid singly or in two-rail lengths. It is not uncommon practice to lay only half the number of ties to a rail length ahead of the train, leaving the rest to be put in by a tie gang following the train, thus somewhat reducing the close work of a large gang, but while a single train may perhaps not do very much damage to a half-tied track, it is, as a rule, better practice to put in the full number of ties before the train runs over the track.

As to the speed of the work, the average is from 1½ to 2½ miles per day, varying according to the nature of the ground, the weight of rails and number of ties, and the general methods of working, while in exceptionally fast work a mile has been laid in 2 hrs. 50 mins. with a gang of 80 men, or, with a much larger gang, from 1,300 ft. in 30 mins. to 11,100 ft. in 8 hrs. 30 mins. On the extension of the Burlington & Missouri River R. R., from Sheridan, Wyo., to Billings, Mont., built in 1894, machine tracklaying progressed at an average rate of 1½ miles per day with a force of 85 men, at a cost of about $100 per mile. Tracklaying by hand, on the same road, was let by contract, about eight years ago, at $300 per mile. This, however, included loading the material and higher wages were then paid than those now ruling. Machine tracklaying on another road, about seven years ago, cost about $150 per mile, which may perhaps be compared with the $300 per mile. On another road, where machine work cost $140 to $170 per mile, hand work cost $250 per mile.

The following particulars of rate and cost of tracklaying in the usual way may be of interest as matter of record, but, of course, variations in price of materials and labor will preclude any direct comparisons. In 1882, on a Texas railway, a tracklaying gang of 164 men in all, with 18 teams, could lay 1½ miles of rails per day, but could not keep up the back work and lay much more than 1 mile; the cost per working day averaged $292, which probably represented the average cost per mile. In 1883, on the Western Division of the Canadian Pacific Ry., tracklaying, with a force of 300 men and 35 teams (about 180 men in the track gang proper), averaged 2½ miles per day, the highest records being half a mile in 35 minutes, 6.02 miles in one day (6 miles 100 ft. of main track and 1,800 ft. of side track, all full tied, full bolted and full spiked), and 25.86 miles in one week (4.31 miles per day). In a discussion on the cost of tracklaying, at a meeting of the Illinois Society of Engineers and Surveyors, in 1889 (Eng. News, May 25, 1889), the figures given were from $292 to $350 per mile, but it was stated that on the Atchison, Topeka & Santa Fe Ry. tracklaying with a force of 164 men for laying two miles of track per day cost $170 per mile for labor only, or $247 for the labor of tracklaying and surfacing.

Some records of work with machine tracklaying are as follows: Fargo & Southern R. R., 1884, 1¼ miles per day, with 40 men; Northern Pacific R. R., 1886, 8,400 ft. in 8 hours, with 67 men (fully tied, bolted and spiked); Northern Pacific R. R., 1889, 4,000 to 5,000 ft. per half-day (work delayed by bridging, etc.) and 9,000 ft. in 6 hours (full tied, half-bolted and quarter-spiked); Lake Shore & Eastern R. R., 1890, 1 mile in 3 hours; Great Northern Ry., 1891, 1½ miles per day for 82 days and 50 miles in 25 days; Nelson & Fort Shepard Ry., 1894, an average of 2 miles per day. In one case 13,200 ft. were laid in 9 hrs. 45 mins. with a crew of 35 men.

The above particulars will serve to show the importance of the machine tracklaying, and further details of the appliances, methods of operation, and organization of the track gangs are given in the article on another page.

LETTERS TO THE EDITOR.

ANALYSIS OF STRAINS IN THE FERRIS WHEEL.

Sir: We beg to announce that we have printed extra copies of p. 72 of the 3d edition of Johnson's "Framed Structures," containing the analysis of the strains in the Ferris Wheel, and we shall be glad to supply this to all possessors of the first and second editions who will send their addresses to us.

Yours truly, John Wiley & Sons.

53 W. 10th St., New York city, Dec. 20, 1894.

COMPENSATION FOR EXPERT EVIDENCE.

Sir: I would like to have your opinion relating to a matter of considerable personal interest, and, possibly, of interest to the profession generally. An assistant engineer in the engineering department of a city has been employed on work pertaining to a new and additional water supply, and was paid for his services by the day, his duties in the field being the supervision of surveys and test-well examinations. The field notes and data thus obtained were afterwards completely mapped and made of record in the City Engineer's office. Later, this assistant engineer was placed in charge of similar surveys and investigations, pending a suit between the city and a private water company. Prior to the trial, he (the assistant engineer) notified the City Attorney, in the presence of the City Engineer, that he was very willing to testify as to matters of fact relating to said surveys and investigations in the field, and the preparation of maps and profiles; but that he would refuse to qualify as an expert, and give expert evidence—along with other engineers employed as experts—without remuneration, claiming that such evidence in the case required knowledge and experience other than that obtained by the local investigations made.* If his professional opinion was of value to the city in the case, the city should pay for the services rendered. Are not such knowledge and experience, and opinions drawn from the same, the very best of a professional man's personal property? Is it fair and equitable treatment, under the circum-

*The City Attorney stated before the City Council that the evidence given was as valuable to the city as any given at the trial.

stances thus briefly outlined, for the City Council to refuse payment of a demand for such service?

Yours respectfully, Assistant Engineer.

(Whether the city had a right to the services of our correspondent, as an expert witness, would depend upon the contract or arrangement by which he was employed. If he were in receipt of a regular salary from the city, it might reasonably be argued that the city was entitled, in return, to the best services he was capable of rendering in any capacity desired. If, on the other hand, he received pay by the day, for such days only as he was actually at work, and was at liberty to use his other time for his own purposes, then his notice to the City Engineer, prior to giving his evidence, would, apparently, legally entitle him to a reasonable rate of compensation as an expert witness.—Ed.)

THE SIZE OF BUILDING BRICK.

Sir: I have read the comments on Mr. Fickes' tests of building brick in your issue of Dec. 15, and as one of the Hudson River brickmakers, I would like to add a few words. You might have a law requiring brick to be of a certain size, but it would be impossible to make them so. One dimension is fixed by the requirements of the New York market (which, by the way, is the largest brick market in this country, and probably in the world, absorbing 1,000,000,000 brick a year).

Five brick laid side by side should measure about 11½ ins., but must not exceed 12 ins. This does not mean that five times the thickness of one brick shall be 11½ ins. This rule fixes the length of the brick for each maker, as brick are set three over one, and the draft of the kiln depends largely on the ratio between these two proportions, as well as the cost of burning and the time required to burn.

If two makers in adjoining yards should use molds of the same size, the brick after burning would probably not be of the same size—in fact, they vary somewhat in different parts of the same kiln, and in different kilns.

The writer speaks of "filling molds a little less solidly." We have to change the press to suit the mud. There would be no profit in what the writer terms a trick to save clay, as to do so would damage the brick and the dumpers would strike at once, as their work would be harder.

Rule No. 5 should be modified. It is true as regards resistance to crushing on the flat, but for transverse strength, the rule should be reversed.

There is no "skinning" about the sizes of brick. A customer usually sees a boatload of brick before purchasing; and if he does not, he knows by the brand what the size will be. I saw many of the brick that Mr. Fickes tested, and there was not one of the larger ones that could be sold for good building brick on the New York Brick Exchange. Please consider that you can usually buy two Hudson River brick for the same price that you pay for one of the larger sizes mentioned. Front brick for the Eastern market are made to-day with the common brick, but slightly larger, as they are repressed and need less mortar. A difference of 1-16 in. in one dimension of the mold often makes considerable difference in the cost of burning and in the quality of the brick made. Experience has taught that it is not practicable, if possible, to burn brick 50% larger than the present size and have them of as good quality as are made at present.

An examination of Mr. Fickes' detailed tables of tests of Eastern brick will show very uniform results. The amount of absorption is not to be relied on as a test, as it depends largely on the process of manufacture and the amount of coal dust, sand and quicksand in the mixture. A brick with excess of quicksand in the mixture will have a better color, absorb less water, and will not be as strong as one with less. Also I think the results of tests of all brick made with soft mud machines show that Rule No. 1 is not warranted by the table. Yours respectfully, C. A. Fowler,

Manager Fishkill Brick Works.

Dutchess Junction, N. Y., Dec. 17, 1894.

TWO POINTS TO BE CONSIDERED IN DESIGNING A STANDARD ANGLE BAR.

Sir: The design of a standard angle bar is receiving some attention at the present time in consequence of the probable action of the American Society of Civil Engineers on this subject at its January meeting. In view of this fact, I desire to call attention to two important features of the angle bar, which, when given proper prominence in the design, have led to some very excellent sections. These two points are stiffness and elasticity.

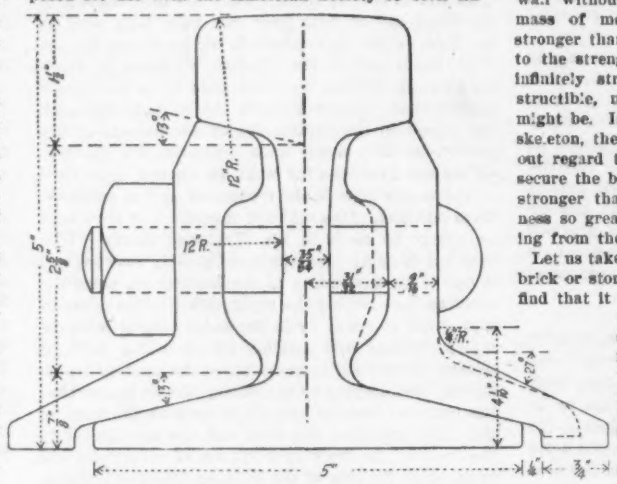
In order to attain proper stiffness, the moment of inertia of the section must be made as great as possible. This requires that the web be made as thin as is consistent with strength, and that the metal be concentrated as far as possible from the neutral axis, in the head and flange. In regard to elasticity, railway engineers do not seem generally aware of the fact that the steel mills are furnishing a metal in the angle plates which is altogether inferior to the metal in the rail.

The following results are taken from a number of tests made at Scranton, Pa., during the summer of 1894, and will serve to illustrate this point:

	Tensile strength, lbs.	Elastic limit, lbs.	Behavior under impact.
Rail steel.....	120,000	60,000	Stood 2,000 lbs. falling 20 ft.
Angle plate steel..	57,000	30,000	Broke under 2,000 lbs. falling 6 ft.

It is evident from the above that a part of the track which is already weak through defective design has its strength further decreased by the use of inferior metal, and indeed this must be the case so long as angle bars are punched and not drilled as are the rails.

This brings out the second point which I wish to make, namely, that by making the web of a proper thinness, say, from 9-16 to ⅝ in. thick, it is possible to punch the plate when rolled of a metal having considerably more elasticity than the steel indicated above. To illustrate these points I have taken the proposed standard angle bar of the Carnegie Steel Co., proposed for use with the American Society of Civil Engineers' standard 80-lb. rail section, illustrated in your issue of Dec. 20, and cut down the web to 9-16 in. thickness and added an equal amount of metal to the flange as shown in the accompanying sketch.



Angle Bars Designed for Stiffness and Elasticity.

(Dotted line shows section proposed by Carnegie Steel Co.)

The following tabulation will show the advantage of this transfer of metal from a position close to the neutral axis, where it adds little to stiffness or strength to a position where its efficiency is much increased. This transfer has also subserved another end, for with the thinner web thus secured it is possible to punch the plate when rolled of a harder and more elastic steel:

	—Stiffness—			—— Elasticity. ——			
Section.	Weight, lbs. per ft.	Moment of inertia.	P. c. inc. of stiffness.	P. c. of carbon.	Elastic limit, lbs. per sq. in.	Moment of resistance, elas. limit.	P. c. inc. of elasticity.
Proposed standard, Carnegie S. Co.	11.5	3.661	....	0.10%	30,000	66,565	....
Section shown in sketch	11.5	4.084	11.6	0.20%	35,000	87,776	31.9

The moment of resistance at the elastic limit is the measure of the ability of the joint to stand up in the track under impact or steady loads without taking a set; and it will be noted that we have increased this resistance 31.9% by an intelligent use of the same amount of metal as that contained in the section proposed by the Carnegie Steel Co. The excellence of plates designed on these lines has been brought very strongly to my notice while inspecting a large variety of sections at the steel mills and in the track. They are doing excellent service on some of the large Eastern railroads, notably the New York Central & Hudson River R. R.

F. W. Gardiner, M. E., Inspecting Engineer.

493 Manhattan Ave., New York city, Dec. 22, 1894.

NATURAL CEMENT AS MATERIAL FOR CONCRETE.

Sir: In your issue of Nov. 20 I notice a letter from Mr. O. M. Harris which contains a fallacy concerning hydraulic cement concrete that I think should be answered. I would not, however, attempt a reply myself if there seemed much likelihood that the point of which I speak would be touched upon by anybody else; but the fallacy has been so often repeated, and so often allowed to pass unchallenged that this must be my excuse for trespassing upon your columns.

Mr. Harris seems to think that no benefit can be derived from having cement that will make a mortar stronger than the materials with which it is used. He says:

> It is often claimed for cement that it proved stronger than brick or stone with which it was laid, and that in taking down old work the brick or stone had to be chiseled through, but the cement would not part from it even then. This quality can honestly be claimed for good natural cement, and can also be claimed for Portland, but if the latter is very much stronger than the brick or stone in concrete and costs twice as much as a cement that still compels the chiselling through stone before parting at the joints, the sole advantage in the use of Portland is to the manufacturer of it, for the use of a bond stronger than the material to be bonded would seem to answer the question of the necessity of using Portland in the asking of it.

In the last sentence, if I read it correctly, lies the error into which Mr. Harris in common with many others has fallen. Let us consider a brick or stone wall laid in cement stronger than the brick or stone. If properly laid the mortar forms a continuous mass in which the brick or stone of the wall is imbedded. This being so, it will be impossible to break or crush the wall without at the same time breaking the bonding mass of mortar. If the mortar should be much stronger than the brick or stone, it would add greatly to the strength of the wall; and if the mortar were infinitely strong and rigid, the wall would be indestructible, no matter how weak the other materials might be. It will be seen that the stronger the mortar skeleton, the stronger will be the wall; and this without regard to the brick or stone filling. In order to secure the best results, the bonding material should be stronger than the material bonded; and its adhesiveness so great that the latter would break before parting from the former.

Let us take another case. Suppose we have a cube of brick or stone which we place in a testing machine and find that it is crushed at a certain pressure. Now let us surround the cube, or one precisely similar in every way, with a jacket which fits it perfectly, and is composed of a material much stronger than that of which the cube is composed. Will it be denied that the resistance of the latter to crushing will be increased, and that the stronger the jacket the greater the increase of resistance? But that is exactly what is done in making the best concrete. The stone is surrounded by the jacket of cement, and its resistance to crushing hereby largely increased. The stone is used in concrete to lessen the cost, not to add strength, as the concrete can never be stronger than the mortar by which the mass is cemented together. The resistance of concrete to crushing is due partly to the resistance of the skeleton of mortar inclosing the aggregates and partly to the resistance of the aggregates themselves. If, then, the skeleton be made stronger, it is easy to see that the resistance of the concrete will be greater, and if the aggregates be braced up by the mortar jacket, it is perfectly apparent that the stronger the jacket, the greater will be the resistance of the aggregates. In fact, the stronger the cement, the weaker the aggregate that may be safely used; and where strong aggregates cannot be obtained, it becomes necessary to use cement of the best quality.

Trusting that I have made my point clear without undue encroachment on your space, I remain,

Respectfully yours, Henry Fulton.

Boulder, Colo., Dec. 19, 1894.

STRENGTH OF CONCRETE AND STEEL IN COMBINATION.

Sir: In your issue of Nov. 8 Professor Schuerman discusses the strength of steel and concrete foundations and derives as a new formula one given in a simpler form in "Modern Framed Structures." Thus his formula (3) is the same as formula (2), p. 446 of the latter work. In your editorial comments you justly say that the steel beams and the concrete will act together, and hence some theory should be deduced to satisfy the known facts of the case.

I have recently had occasion to test a concrete beam with a steel rod inserted near the bottom, and have made the following analysis of the problem, which I submit as such a solution as you demand:

There are three cases to the general problem:

I. Strength of the combination when concrete cracks at bottom.

II. Strength when steel bar passes its elastic limit.

III. Strength when concrete fails in compression on the compressed side.

In the two last cases the concrete part of the beam has been broken in two long before these limits are reached. The cause of this is that the ultimate strength of the concrete is not as great as that of the steel when at or slightly beyond its elastic limit.

Case I.

In this case we assume the concrete is not to crack on the tension side of the beam. The problem now is to find to what extent the steel rod, placed in the concrete (or outside of it, if it only be rigidly joined to it), strengthens it up to this limit of rupture by tension. The controlling fact is, that when the steel rod is rigidly attached to the concrete, which it always is when buried in it, the distortion (extension or compression) of the steel bar is the same as that of the concrete in the same horizontal plane. But if the distortions are the same, the stresses, or their resistances to distortion, are as their rigidities, or as their modul of elasticity.

Now the modulus of elasticity of steel may be taken as 28,000,000, while that of concrete is about 1,000,000. In other words, since steel is 28 times as rigid as concrete, it resists 28 times as much as the same area of concrete, for equal distortions. We may, therefore, replace the steel or iron bar by 28 times its own area of cross-section provided we put this new area of concrete in the same horizontal plane with the iron or steel bar. This may be done as follows:

Assume a rectangular concrete beam, as in Fig. 1, with a square steel bar embedded in it near the bottom, as shown. This combination of steel and concrete may be replaced by an all-concrete beam as in Fig. 2

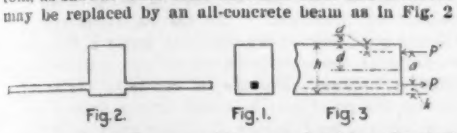


Fig. 2. Fig. 1. Fig. 3

in which the flanges are of the same height as the steel bar and occupy the same horizontal position. The total width of flanges, however, is equal to 28 times the width of the bar. We can now find the neutral axis of this form of section and the moment of inertia of the same, and thence its moment of resistance in terms of the stress per square inch on the bottom fiber and the distance of this fiber from the neutral axis. This will be the moment of resistance of this beam, and hence of the original composite beam, when the stress on the extreme fiber is taken as the ultimate tensile strength of the concrete.

Case II.

Strength When Steel Bar Passes Its Elastic Limit.—If the beam is loaded beyond the limits of strength by Case I. it cracks at the bottom, and it is then held together only by the steel bar. Failure can now occur either by the stretching out of this bar or by the crushing of the concrete at the top. We will now consider the former limit.

In Fig. 3

let P = pull of steel bar at its elastic limit;
" P' = resistance of concrete to compressive stress, = P in simple cross-bending;
" d = portion of height of beam under compressive stress;
" h = height of beam;
" k = distance from center of bar to bottom of beam;
" a = vertical distance between the points of application of P' and P'.

The problem is to find d, and hence a, where the failure occurs by the failure of the steel bar. Since the compressive stress is a maximum at the top and may be supposed to diminish uniformly until it becomes zero at the distance d below the top, and below this the beam exhibits an open crack, we have

P = elastic limit of steel bar = 40,000 A where A = area of cross-section of bar;

$P' = \frac{f\,b\,d}{2}$, where f = compressive stress on outer fiber;

and b = breadth of beam.

Whence, since P = P', we have

$$d = \frac{2\,P}{f\,b} = \frac{80{,}000}{f}\,(.)\,\frac{A}{b} = \frac{80{,}000}{f}\,h. \qquad (1)$$

Whence

$$a = h - k - \frac{d}{3}, \qquad (2)$$

since P' acts at a distance $\frac{d}{3}$ below the top.

Now the moment of resistance of the beam is

$$M_0 = P'_a = P\left(h - k - \frac{d}{3}\right) \qquad (3)$$

If we know f, we can find d, and hence a and M_0. Or, if we know d we can find f and M_0. Since we have no means of knowing either of these with certainty, we must abandon this case as undetermined or make an assumption. We would err on the side of safety by making d large and a correspondingly small. We know d is less than h since the beam has cracked at the bottom. If we make $d = \frac{h}{2}$ it will not be far wrong.

Then we would have, $a = \frac{5}{6}\,h - k$ and

$$M_0 = P\left(\frac{5}{6}\,h - k\right) \qquad (4)$$

If we examine this, we see that the moment of resistance increases as k diminishes, or as the bar is placed nearer the bottom of the section. When placed on top of a concrete base, as in foundations, then it would be in compression, and Case I. alone would apply.

Case III.

Strength When the Concrete Fails by Compression.—After the concrete has cracked at the bottom, if the bar is strong enough the concrete will be eventually crushed at the top. For this case we have f at the top equal to the ultimate crushing strength of the concrete, which may be taken as 500 lbs. per square inch for good natural cement, and as 1,500 lbs. per square inch for good Portland cement concrete. In this case P is unknown, since the iron bar is not supposed to fail, and we are as badly off as before as to the value of d. If we again assumed $d = \frac{h}{2}$ we have as before

$$P = P' = \frac{f\,b\,h}{2} = \frac{f\,b\,h}{4} \qquad (5)$$

and $a = h - k - \frac{d}{3} = \frac{5}{6}\,h - k$ as before..

Whence,

$$M_0 = P'_a = \frac{f\,b\,h}{4}\left(\frac{5}{6}\,h - k\right) \qquad (6)$$

in which if f, b, h and k be evaluated the moment of resistance is found. To learn whether failure would occur by Case II. or Case III., we have only to find P by Eq. (5) and compare it with the known elastic limit of the steel bar. If it is greater than that limit, failure will be by Case II., and if less, by Case III.

Various special cases will occur, as when I-beams are buried in concrete, but it is thoght the above will indicate a general method in accordance with which any particular case may be worked out.

J. B. Johnson.

Dept. of Civil Engineering, Washington University, St. Louis, Mo., Nov. 30, 1894.

WATER SUPPLY UPON SANDY TIDE-WATER COASTS.

Sir: In your issue of Nov. 22, 1894, you published an article by me headed, "Water Supply upon Sandy Tide-Water Coasts," with editorial comments. These concede the following points: "As a source of water supply, saturated beds of clean sand and gravel, like those found on the south side of Long Island, possess advantages in purity and in steadiness of supply up to certain limits." "His general statement of the operation of driven wells is correct;" and confirm that "if the supply is forced by heavy pumping, surface impurities may enter the tubes." The other comments seem generally more tentative than conclusive opinions, seemingy intended to draw out proofs of the writer's position.

It is stated that the Brooklyn water department claims 35 or 30 ins. as the annual rainfall, instead of 42 ins. Among the earlier distinguished engineers who prominently became familiar with the hydrographic peculiarities of Long Island are Dewitt Clinton, D. B. Douglass, Wm. J. McAlpine, W. B. Burnett, Chas. B. Stuart, Saml. McElroy, Jas. P. Kirkwood, Moses Lane, and others. No man living is more generally familiar with the convictions of these distinguished men upon these questions than Samuel McElroy, who virtually designed and executed that part of the Brooklyn water works which conforms to and takes advantage of the favorable peculiarities of Long Island in this respect, and has spent the best part of a life-time in similar work upon the Island. He states that 42 ins. is an underestimate of the annual average rainfall, which is sustained by the observations made at Flatbush and in New York. During the inception of the Hempstead reservoir folly, other figures crept into the records, and are still quoted, unconscious of the want of facts to sustain them.

The writer claims 25 ins. of rainfall (60% of 42 ins.) to move through the sand to the sea annually, amounting to 1,200 million gallons per day upon the south shore alone. The editorial states that 15 ins. are "consumed by evaporation, vegetation and by soaking into the ground." The latter, not defined by figures, percolates towards the sea, leaving 15 or 20 ins., which the editorial claims either run directly into the streams or form springs, the latter necessarily also "soaking into the ground" before it can form springs.

The fallacy of this argumentative assumption that a large quantity runs directly into streams, is shown by the fact that, for instance, upon the Hempstead Plains there are no beds of streams either in a seaward or in any other direction for about five miles; beyond that distance they being generally formed by and below springs. Over this entire section the rain, as a rule, passes vertically downward until it meets the vast saturated bed of sand and gravel. The distinguished veteran engineer, Col. Julius W. Adams, affirms this fact by his testimony in court:

"Q. Will sand saturate over 500 ft.?" A. "Yes, this sand will." Q. "Is that sand a peculiarly porous one?" A. "It goes for miles. It" (the water) "would all run away."

McAlpine stated in 1871: "I did then" (in 1851) "express a decided opinion that in this peculiar soil, differing from any other almost in the country, it was very doubtful whether you could impound and hold back water in any considerable quantity." This opinion is the natural deduction from the fact that for about five miles no seaward or other storm channels exist; and that therefore the ground is sufficiently porous to absorb the water before it can accumulate into streams.

Chief Engineer Van Buren's report of 1880, to the effect that he obtained only 9½ ins. in that dry season, is not to the point, as it accounts principally for the overflow only of this gigantic natural reservoir, unconfined upon all sides, and virtually unchecked in its flow towards the sea. But even at the low figures of underground flow, say, of 10 ins., only 33% of the lowest rainfall the editorial quotes, the daily waste along the south shore alone is near 500 million gallons—over five times the amount Brooklyn uses, with the waste along the north shore in reserve. This should banish the remotest idea of going outside of Long Island for its water supply.

Referring to the writer's claims of unlimited storage capacity and greater purity of supply by reason of the water rising vertically through from 10 to 125 ft. of sand, and thousands of feet horizontally, the editorial says: "We beg to differ with him radically," but gives no reason for this difference. Nor can any maintainable reason be given. It farther says: "The water flows down the slope as over a sheet of ice, and that is all the galleries of the gravity system would intercept." This is granting that it could be intercepted, the question being only as to the quantity. Water will not percolate through thousands of feet of sand to the sea if it cannot find a shorter outlet. Such galleries within the saturated bed form such shorter outlets, into which the water must flow from all sides and from underneath. The editorial says. "The enormous storage reservoir of water-saturated sand, to draw upon for an indefinite quantity, does not exist." If such a bed is saturated, it contains at least 33% of water. And if, as the editorial states, only "about 10% will remain in the mass to moisten it,"—23% remains available; wherefore the southern slope of Long Island—about 1,000 sq. miles in extent, forms a storage reservoir capable of releasing 70,000 million gallons for every foot in depth, 700,000 million gallons for 10 ft. in depth—enough to supply Brooklyn for 20 years without a drop of rain during one-fifth of a century, with the north shore still in reserve—if its waste into the sea could be prevented.

The editorial farther says: "Such a system would waste all the rainfall now intercepted by the surface storage basin system." In the first place, the absence of water channels upon a large part of the Island proves that the surface flow, except from springs, which underground galleries would more or less estop, is comparatively small. In the second place, the underground collection of filtered water does not preclude the use of the surface water. In the third place, where the sources of naturally filtered water are so abundant, the unclean surface water, now contaminated with some of Jamaica's sewage, should by all means be excluded. At times such surface water is so roily, that house filtering is necessary to remove the thickest contamination. In the fourth place, as recognized by McAlpine, as stated, and by many other able engineers, storage basins upon Long Island formations repress the flow, forcing it into other channels. The Hempstead reservoir, for instance, besides this repression, has actually diminished the available water supply of the Island, by the destruction of the fine timber previously around and over it, and otherwise enlarged evaporation by the extensive surface of its generally shallow basin, without any counterbalancing advantageous effect. These unnecessary pigmy attempts at storage at enormous expense, in the face of nature's indisputable grand provision, is an anomaly in engineering for which no satisfactory explanation can be made.

In brief, the editorial admits that a water supply from "saturated beds of clean sand and gravel possess advantages in purity and in steadiness of supply up to certain limits;" admits the defects of driven wells; admits of a waste of such pure water into the sea; gives no definite reason for "differing with him" (the writer) "radically;" does not affect the minimum figures given, to wit, 500 million gallons flowing into the sea daily along the south shore alone; does not refute the fact that nature's storage on the south side alone is far beyond all possible requirements of Brooklyn; recognizes that water must fill such "galleries" located under the surface of the saturated mass of sand; does not give acceptable reason for using the washings of the surface, in preference to an abundance of filtered underground water; gives no good reasons for continuing the reservoir system, fatal upon such formations:

and finally states that "The use of galleries to intercept this annual flow down the hydraulic grade line has long been favored by the engineers of the Brooklyn Department," . . . and that "The scheme is now practically in use in the system." But it is evident that the great value of the system is not as yet recognized, nor the great defects and impracticability of the storage system upon such porous sand formations.

Robert Creuzbaur.

58 Broad Street, New York city, Dec. 14, 1894.

(We must still adhere to our figures for rainfall, as coming from the only official source available, the records of the Brooklyn Water Department and the statement of so experienced an engineer as the late James P. Kirkwood. We distinctly gave this rainfall as an average of a number of years, the only safe guide in estimating upon a future supply. As our correspondent now seemingly admits, in his later estimate of quantity, that rain water held in suspension in the sand below the hydraulic grade line is unavailable as storage, he must also admit that his galleries must depend altogether for a supply upon that part of the annual rainfall that soaks into the ground and is not taken up by vegetation, evaporation, or in maintaining moisture in the soil, or that does not escape by springs to surface streams or "run off" over frozen ground. He assumes 1,000 sq. miles of available collecting surface. But the whole area of Long Island is only 1,682 sq. miles, and as he especially "reserves" the northern slope, his collecting conduit would have to be about 100 miles long (the extreme length of the Island is only 115 miles), with the much too liberal assumption that his southern slope had an average width of 10 miles out of the 14 miles, which is the average width of the Island. It is the cost of such an undertaking, compared with the quantity of water obtainable, and the fact pointed out by Mr. Kirkwood that the topography would demand the installation of a number of large pumping stations along the line of such a conduit, that stood in the way of the recommendation of such a system by Mr. Kirkwood, 30 years ago, and still makes any such attempt impracticable, from a financial standpoint. So that for all practical purposes we must still say that "the enormous storage reservoir of water-saturated sand, to draw upon for an indefinite quantity, does not exist." We would ask our correspondent, before discussing this question further, to carefully estimate the cost of this 100 miles of conduit, with its attendant pumping stations, pumping mains and accessories; and then to compare this cost with the percentage of the annual rainfall secured, after deducting from this rainfall the annual "run-off." We think he will then better understand why "the great value of this system is not as yet recognized." The five miles of Hempstead Plains are practically without watercourses to the sea, as our correspondent says. But this plain is even now thickly settled and the extreme permeability of the soil referred to would in time make suspicious any underground supply taken from it; so that this 50 sq. miles, though the easiest for an interception scheme, should be eliminated for the future supply of Brooklyn, as its condition would steadily grow worse with an increase in population. Beyond Hempstead,streams to the sea are frequent, the land towards the sea is low and abounds in swamps. To intercept on the higher land reduces the collecting area and increases the cost, owing to the depth of the galleries. To put the galleries near the sea would require very troublesome and expensive engineering work, an entirely separate gravity conduit on the higher ground to reach Brooklyn and many pumping stations to lift the intercepted water into this conduit. This scheme has been carefully studied—and rejected—by the majority of the famous engineers referred to by our correspondent, and the same consideration of excessive cost still interferes with the utilization of this underground flow in the manner proposed by Mr. Creuzbaur. It is not so much a question of the quality and quantity of the underground water, as it is of the cost of gathering and conveying this water to Brooklyn.—Ed.)

THE COMPARATIVE VALUES OF COARSE AND FINE SAND FOR CEMENT MORTAR.

Sir: Having noticed in Engineering News the statement that a very small percentage of mud did no harm to cement mortar, I concluded to test the matter, and as other engineers may be interested by these tests, I send the results in a condensed form in the accompanying table. As will be seen from the table, I also tested the comparative value of coarse and fine sand for making cement mortar, and the effect of using salt water in gaging.

Table Showing Effect of Coarse and Fine Sand, of Salt Water, and of Different Percentages of Mud Upon the Strength of Cement Mortar.

Composition of Briquettes.	Fresh water. 1 day. No. Br'q'ts.	Fresh water. 1 day. Stress, lbs.	Fresh water. 7 days. No. Br'q'ts.	Fresh water. 7 days. Stress, lbs.	Salt water. 1 day. No. Br'q'ts.	Salt water. 1 day. Stress, lbs.	Salt water. 7 days. No. Br'q'ts.	Salt water. 7 days. Stress, lbs.	2.4% mud. 1 day. No. Br'q'ts.	2.4% mud. 1 day. Stress, lbs.	2.4% mud. 7 days. No. Br'q'ts.	2.4% mud. 7 days. Stress, lbs.	0.1% mud. 1 day. No. Br'q'ts.	0.1% mud. 1 day. Stress, lbs.	0.1% mud. 7 days. No. Br'q'ts.	0.1% mud. 7 days. Stress, lbs.	17% mud. 1 day. No. Br'q'ts.	17% mud. 1 day. Stress, lbs.	17% mud. 7 days. No. Br'q'ts.	17% mud. 7 days. Stress, lbs.
Neat cement	19	129	17	163	11	99	8	140	2	113	7	147	3	77	5	116	2	65	4	65
1 cem't: 1 b'ch sand	6	47	10	71	1	62	2	78	4	39	7	58	4	34	3	27	2	30	3	23
1 cem't: 1 riv'r sand	5	45	10	64	1	48	2	79	4	47	6	58	4	34	7	33	2	32	3	28
2 cement: 1 beach and 1 river sand.....	5	48	11	74	1	56	2	79	..	...	..	...	..	...	..	...	..	...	..	...
2 beach s'nd: 1 cem't	2	9	3	29	1	16	2	28	..	...	..	...	..	...	..	...	..	...	..	...
2 river s'nd: 1 cem't	2	10	2	23	..	...	..	...	..	...	..	...	..	...	..	...	..	...	..	...
1 cement, 1 river and 1 beach sand	1	8	3	28	..	...	..	...	..	...	..	...	..	...	..	...	..	...	..	...

Note.—The river sand was coarse; the beach sand was fine.

These tests were made at Fort Pulaski, Georgia, where a mining casement was being built, which required the use of about 2,500 cu. yds. of concrete. Beach sand was near at hand, and could be put into the concrete for 35 cts. per cu. yd., whereas the river sand would cost $1.25 per cu. yd. It was principally to see if the beach sand would be suitable for the work that the tests were made, and every one connected with the work was surprised at the results. I send you herewith samples of the two sands. The briquettes were made in brass models and had an area of 1 sq. in. at the breaking section. In mixing the paste the cement and sand were first measured and mixed dry on a stone slab. Water to the amount of 25% of the cement in bulk, with a little additional to moisten the sand, was then added and the whole thoroughly mixed. In adding the water care was taken not to add it so rapidly as to drown the cement. The paste was rammed into the models with a stick having an end section about ¼ in. square. The ramming was done as evenly as possible and then the models were struck even with a trowel. The briquette was taken out immediately and set one side for 24 hours, after which it was immersed in water. In case salt water had been used for gaging, the briquette was stored in salt water.

The mud used as an adulterant was from a salt marsh and was probably composed largely of vegetable matter, with possibly a little loam or clay. It was dried under a stove, ground as fine as flour, and then added to the cement and sand in amounts necessary to get the various percentages in bulk.

The breaking was done on a Fairbanks testing machine, using shot for the weight. All possible care was used and the fact that different briquettes in the same set often broke within 1 lb. of each other and rarely differed 15 lbs. in strength, even on neat cement, goes to show that the results cannot be accidental. From these tests I have drawn the following conclusions:

(1) Fine sand is better than coarse sand for cement mortar.

(2) Fine and coarse sand mixed are better than either fine or coarse sand for cement mortar.

(3) Salt water when used for gaging cement or cement mortar is injurious; but it is more injurious to neat cement than to cement mortar.

(4) Any amount of mud mixed with neat cement or cement mortar is injurious in direct proportion to the amount used. Where the cement is mixed with sand the ill-effect of the mud is less with coarse than with fine sand.

I am well aware that everybody has a prejudice against fine sand, but it is more of a notion or tradition than a well-founded principle established by reliable experiments. In this case, about $1,000 was saved by using the beach sand, and I send you these results with hopes that some other engineer may get the benefit of the facts brought out by them.

Yours respectfully, A. S. Cooper,
U. S. Assistant Engineer.

Savannah, Ga., Oct. 31, 1894.

(The samples of the two sands sent to this office by our correspondent show the river sand to be a quartzose sand, slightly yellowish in color, with the grains sharp and angular and varying in size from the size of a period mark (.) to the size of a capital O, in this type, most of the grains being about one-half the size of a small, or lower case, o. In brief, the sand is about what a plasterer would select as proper for ordinary plastering. The beach sand is very fine—so fine, indeed, that the shapes of separate grains cannot be seen without the aid of a magnifying glass. The grains are quartz, very regular in size, and possibly somewhat more rounded than those of the river sand. It is practically the so-called "blown" sand, such as forms the shifting sand hills along the sea coast in places. Both sands were clean and free from vegetable matter. In reference to the tests themselves, our correspondent is mistaken in supposing that the generally accepted belief that coarse sand is better than fine sand for cement mortar is based on nothing better than a "notion" or "tradition." As far as experimental evidence goes, few of the accepted truths regarding the physical characteristics of cement mortar are better established. Records of extensive series of tests on this point may be found by our correspondent in papers read before the Institution of Civil Engineers, in 1865 and 1871, by Mr. John Grant, M. Inst. C. E.; in "Annales des Ponts et Chaussees," vol. II., 1890; in Professor Cundlot's book, "Ciments et Chaux Hydrauliques," and in the annual report for 1893 of Col. O. M. Poe, U. S. Engineer Corps. Other records of such tests can be referred to, but these are sufficient for the present purpose. To what extent the experiments recorded in the accompanying table justify the conclusions stated in the letter, we leave our readers to judge for themselves.—Ed.)

NOTES AND QUERIES.

J. B. asks for a book of tables which will show the horsepower per ton required for propelling electric or steam cars on different grades. If he will memorize the sample rule on p. 540 of Wellington's "Economic Theory of Railway Location," he will have no need for a book of tables. This rule is:

The grade resistance in pounds per ton = the rate of grade per cent. × 20.

This, of course, refers to the grade resistance alone. The rolling and axle friction, the friction of machinery and the power necessary to accelerate the car when starting must also be taken into consideration to find the actual force required to be exerted on the car. When this force is found, the computation of the horsepower necessary is a simple matter, if it is known what speed it is desired to make. It must be remembered that a horsepower is not a given amount of work, but is a rate of doing work, or the capacity to do work at a certain rate.

TESTS OF TIGHTNESS OF CEMENT JOINTS IN VITRIFIED PIPE SEWERS.

The importance and difficulty of securing tight joints with vitrified sewer pipe is now pretty well impressed on the minds of engineers engaged in the construction of separate systems of sewerage. Some interesting experiments with joints of different forms and material have been made by Mr. Freeman C. Coffin, of Boston, and were described in a recent paper, read before the Boston Society of Civil Engineers.

Mr. Coffin states that it is almost impossible to make a perfect cement joint in a wet trench, owing to the short lengths of pipe, which renders it difficult to dig bell holes large enough to work in, and also admit the suction pipe of a pump without danger of getting the pipe out of line. The shallowness and thinness of the ordinary standard joint is also against good work. Deep socket pipes, made by the Portland Stoneware Co., have recently been used in Brockton, Mass. These joints are 2⅝ ins. deep for pipe from 4 to 12 ins. in diameter, 3⅛ ins. for 15, 18 and 20-in. and 4 ins. for 24-in. pipe, the joint room in all sizes being ⅝ in. in thickness. The standard socket is shown in Figs. 2 and 3 and the deep socket in Figs. 4 and 5, 6-in. pipe being represented in each case. Figs. 3 and 5 show an overfilled joint, designed to prevent the inflow of water, but when such joints are made in a wet trench it is nearly im-

possible to keep the mortar intact until it sets.

Regarding the method of conducting the tests, Mr. Coffin says:

It was not practicable to reproduce the exact conditions to which the joints are subjected in the trench, but in order to approximate them as closely as possible, I made a tank as shown in Fig. 1, in which the pipes could be placed with one open end projecting and with the joints under water pressure from the outside, as in a sewer when the ground water is higher than the pipe; the leakage to be carefully collected from the projecting open end of the pipe.

All of the tests in this tank were made under a uniform head of 5 ft. above the center of the pipe, assuming that this might be nearly an average of the head of ground water, or at least it would be a means of comparing the relative value of the different joints in resisting the seepage of the water.

The head was obtained by a ½-in. pipe screwed into the top of the tank, having at the top a tin pail into which the supply is conducted by a hose and with an overflow in the side, by which a uniform head was maintained by allowing a small amount of water to continually run into the pail.

The pipes that were used were all 6 ins. internal diameter, and in lengths of 1 ft., made so for convenience in handling. The plugs were simply pieces of pipe of the same diameter, 6 ins. long, with a closed end; the pipes and plugs are shown as they were placed in the tank in Fig. 1.

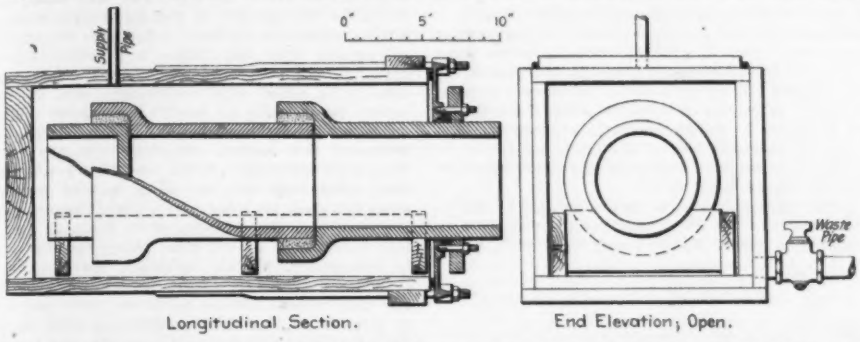
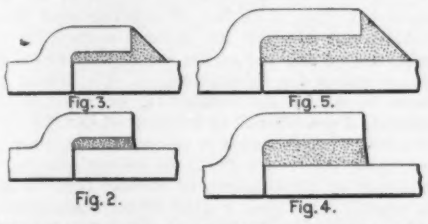


FIG. 1. APPARATUS FOR TESTING LEAKS IN VITRIFIED SEWER PIPE WITH CEMENT JOINTS.



Figs. 2 to 5. Standard and Deep Sockets, with Flush and Overfilled Joints.

There were three forms of joints: The standard joint, shown in Figs. 2 and 3; the deep socket, shown in Figs. 4 and 5; and deep socket with roundabout grooves in the inside of the socket and outside of the spigot end of the pipe.

I had some apprehension while preparing for these tests, that they might be failures as tests, by reason of there being no leakage in a perfectly-made joint under so light a pressure. To have the tests of any value, it was necessary to make the joints in as uniform a manner as possible, and therefore as well as could be done, which it was comparatively easy to do with the pipe in a vertical position during the process. Under such conditions it seemed possible, if not probable, that the result might be no measurable leakage, and therefore no means of comparing the different kinds of joints, but my fears were unnecessary, for Table No. 1, a consecutive record of the tests, shows that there were only 3 tests out of 63 that showed no leakage, and this result in those was not secured by cement alone.

The method of making the experiments was generally as follows: They were made in a light, cool basement, with the temperature in the vicinity of 50° F. The pipes were placed upon end with the sockets up, and the plug or stopper in the upper one, two 1-ft. lengths in each experiment, making two joints in each test. The cement was carefully packed into joints, and rammed with a wooden rammer to compact the mortar as much as possible in the joint. The outside of the joint was carefully smoothed with a smooth tool, a steel table-knife, in fact, being the most convenient to work with. After the joints were made, they were covered with a damp cloth, which covered the whole pipe to the floor, and allowed to stand undisturbed in that position until the end of the time of setting. They were then placed upon the wooden cradle and put into the tank, the end of the tank and the stuffing box were placed in position and the water let in. The leakage was not collected for measurement until both joints seemed to be running at their full or normal rate, when the time was noted, and the collection commenced. The duration of the tests varied according to the amount of flow and my own convenience, as the tests were mostly made before and after business hours. At the end of the test the time was noted, and the leakage measured in a glass graduated to ounces and fractions of ounces.

The results of the tests are shown in detail by the accompanying table, slightly condensed from the original. The leakage per mile is based on 2-ft. lengths of pipe, or 2,640 joints per mile. The table is supplemented by the diagram, Figs. 6 to 13, where the averages of different classes are compared graphically and by figures.

Mr. Coffin's discussion and interpretation of the results of the tests are as follows:

In standard pipe a joint (Test 61) made of neat Portland cement, with a set of twelve hours, leaked only at the rate of 67 gallons (all figures will be per mile per 24 hours). Rosendale, 1 to 1, gave a leakage of 130 gallons, average of Tests 6 and 7; both of these were overfilled. With flush joints: Rosendale, 1 to 1, gave 2,004 gallons, average of Nos. 1 and 25. Rosendale, neat, flush joints, gave 206,000 gallons, average of Nos. 2 and 3; Rosendale, neat, overfilled, gave a leakage of 162,283 gallons, average of Nos. 4 and 5.

This would show extremely good results with Portland and Rosendale, 1 to 1, if it were possible to make joints of good quality in the trench.

Comparing four tests of standard pipe with four of deep socket pipe of similar kind, as per Fig. 6, we find the leakage in the standard equals 1,017 gallons and in the deep socket, 585 gallons. These joints were Rosendale, 1 to 1. The apparent eccentricity of No. 25 caused the leakage to be greatest in the standard. My opinion is that with equally well-made joints the seepage would vary as the thickness of the joint, and inversely as the depth. This would seem to be indicated by the next comparison.

Comparing flush with overfilled joints, as per Fig. 11, we find a decided gain from overfilling, but there will also be noted a greater eccentricity of results in the overfilled joints.

Rosendale Cement.—In comparing the different mixtures of Rosendale it is rather surprising to find that the cement neat makes a poorer record than either a mixture of 1 to 1 or 1 to 2 of sand, and this is a persistent condition, for with great irregularity in the record of the tests of the neat cement, every one of them far exceeds, in the amount of leakage, those of the same kind made with 1 of cement to 1 of sand, and the averages for corresponding tests, as shown by Fig. 12, are 139,949 gallons for the neat cement, and 1,121 gallons for 1 to 1, or over 100 times as much for the neat cement.

There was one test of 1 to 1, No. 11, which ran as high as some of the neat tests; this did not correspond in conditions to any of the neat tests, and was not included. If this had been included in the average, it would have made it 19,861 gallons, or about 1-7 of the average of the neat cement.

Comparing Rosendale, 1 to 1, with 1 to 2, as per Fig. 7, the average leakage of 1 to 1 is 744 gallons, and of 1 to 2, 1,207 gallons.

Portland Cement.—Portland neat compared with 1 to 1 shows, as per Fig. 8, an average of four similar tests of each, for neat cement, 133 gallons; for 1 to 1, 595 gallons. Comparing joints made of 1 to 1 Rosendale, finished with neat Portland ½ in. deep at the outside of the joint, shows, as per Fig. 9, an average of two similar tests of each: Portland neat, 68.5 gallons, and finish of ½ in. of Portland neat, 237 gallons, which also indicated that the seepage is in inverse ratio to the depth of the joints, as before noted.

Portland and Rosendale.—Comparing Portland and Rosendale, Fig. 8 shows for different mixtures as follows: Four similar tests of each, Portland neat, 133 gallons; Portland 1 to 1, 595 gallons; Rosendale, 1 to 1, 712 gallons. On a basis of 12 hours set, as per Fig. 9, two similar tests of each, the figures are: Portland neat, 68½ gallons; finish of ½ in. Portland neat, 237 gallons; Portland 1 to 1, 336 gallons; Rosendale 1 to 1, 744 gallons.

Time of Setting.—Comparing the results of 1½ hours set with 12 hours set gives, as per Fig. 10, average of six tests of each: 1½ hours set, 578 gallons; 12 hours set, 383 gallons.

The following table gives a comparison of the results of six tests in which the joints were first tested with twelve hours set or less, and afterward with a longer set.

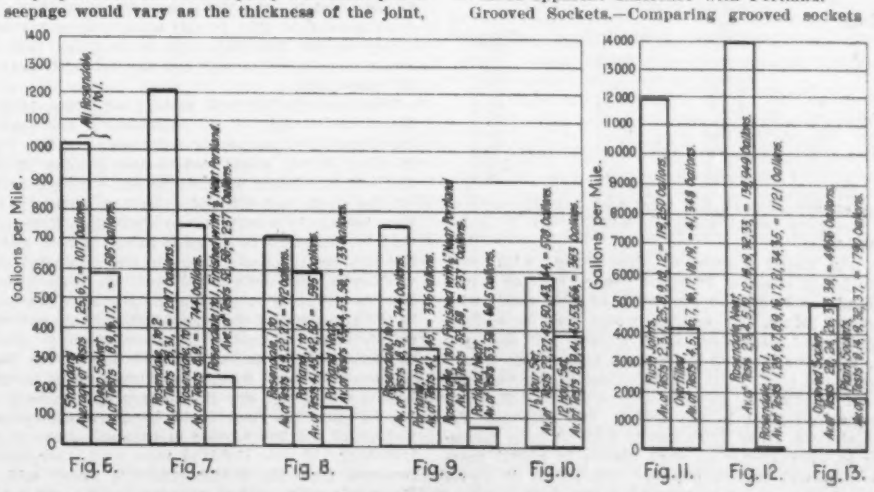
Table Giving Comparison of Leakage with Increased Time of Setting.

	—First test—		—Second test.—		—P. c. of—	
No. test.	Length of set, hrs.	Leakage, gallons.	Length of set, hours.	Leakage, gallons.	Reduction.	Increase.
7	12	102	288	78	13.6	...
10	12	285,000	36	191,000	23.0	...
11	6	216,000	16	160,300	15.7	...
12	12	251,500	18	272,000	....	8.5
14	12	1,056	43	823	12.0	...
19	12	4,820	24	4,330	10.0	...

Mortar Mixed Wet or Dry.—On this point the results were rather contradictory, but seem to show the best when the mortar was of such consistency that the largest amount would stay upon a trowel, neither falling apart from dryness nor running from moisture. This was especially true of Rosendale, but not so much apparent difference with Portland.

Grooved Sockets.—Comparing grooved sockets with plain ones gives, as per Fig. 13, six similar tests of each: Grooved, 4,056 gallons; plain, 1,[illegible] gallons.

Gasket.—Two tests were made with jute gaskets untwisted, and saturated with neat cement grout of the kind of cement used for the joints. The results, compared with similar tests without gaskets, are:



FIGS. 6 TO 13. DIAGRAMS FOR THE COMPARISON OF AVERAGE RESULTS OF DIFFERENT CLASSES OF JOINTS.

Rosendale 1 to 1, 12 hours set, with gasket, 1,050, and without, 950 gallons; Portland neat, 12 hours set, with gasket, 323, without, 98 gallons. The test without gaskets, taken for comparison, gave the highest leakage of any of their class, the average being respectively 744 and 68.5 gallons. The gasket occupied about one-fourth of the depth of the joint. These tests also indicate that the seepage is in inverse ratio to the depth of joint.

Joints Made with Pipe in a Horizontal Position.—One test was made of joints made with pipe lying in a horizontal position as in the trench. Much trouble was experienced in making these joints, and about as much time was consumed as would have been required to make four or five sets with the pipe in a vertical position, and it was difficult to use the mortar dry enough to prevent it settling down from the top of the joint. The first joint of the two was made with very dry mortar, but it was necessary to go over it three times before it set enough to remain in place. The other joint was made of mortar so dry that it presented the appearance of moist sand with no cohesion unless compressed. This was rammed into place with a wooden rammer, and both joints were finally successful with a leakage of 118 gallons as compared to 98 gallons, the greatest leakage in Portland neat made in a vertical position. These joints were deep socket, and it is probable that wetter mortar could have been used in the standard

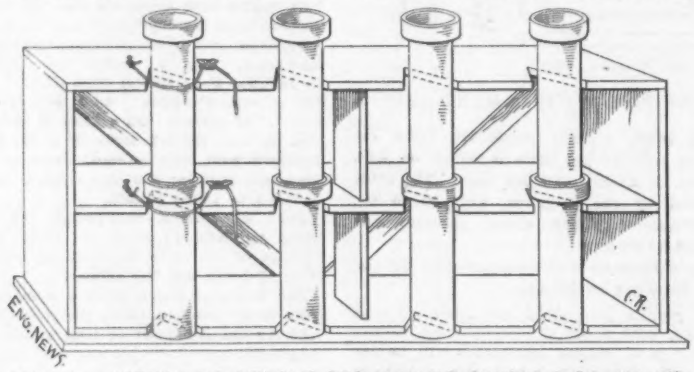


FIG. 14. SKETCH OF CRADLE FOR MAKING SEWER PIPE JOINTS.

without sloughing down, but I doubt if so good a joint could have been made in the standard in that position.

Asphalt-Painted Joint.—More form curiosity than from any idea that it would be a practicable method, I treated some joints, after testing, by painting with asphalt cut with turpentine, known as Warren's Asphalt Varnish, T. Brand. The outside of the joints was painted three coats one after the other as they soaked in and dried. They were then tested again, and the result is shown in the following table:

Table Giving Leakage of Ten Tests, Before and After Being Painted with Asphalt Varnish.

No. of test.	—Leakage in gallons.— Before painting.	After painting.	P. c. of reduction.
7 A	85	0	100.0
11 A	169,390	8,350	94.8
18	285	0	100.0
25	3,605	105	97.0
20	7,240	713	90.0
27	437	82	71.2
28	1,618	1,060	35.6
30	2,370	740	68.8
35	616	0	100.0
45	308	41	86.9

An examination of the tests and a comparison of the averages would seem to lead to the following conclusions:

In the standard form of pipe socket, with well-made joints of either Portland cement neat or 1 to 1 of sand, or Rosendale cement 1 to 1 of sand, with overfilled joints, the leakage would not be serious, probably not to exceed 1,000 gallons per mile per day, with the level of the ground water from 2 to 8 ft. over the pipe. But the smallness of the room for cement in this joint renders it exceedingly difficult to make a full joint in the trench, and although the tests show a fairly good result, I think it is impossible to approximate to such results in actual practice in a wet trench, and for this reason it would seem wiser to use a larger and deeper socket where tight work is desirable.

In pipe with deep sockets the tests would indicate that if the joints are well made the leakage would be about as follows: In Rosendale cement neat it would be very large, perhaps over 100,000 gallons per mile per day. In Rosendale cement mixed with sand in the proportion of 1 to 1, the leakage would not exceed 700 or 800 gallons per mile per day. In Rosendale mixed with 1 part of cement to 2 parts sand, it would approximate 1,000 or 1,200 gallons per day. With Portland cement neat, about 150 gallons per day, and mixed 1 to 1, about 500 or 600 gallons.

The advantages of the wider and deeper sockets are in the greater ease with which the mortar can be put into the joint, allowing of the use of a wooden rammer of sufficient thickness to be effective in compacting the mortar, the greater depth or length of the joint along the pipe, which apparently reduces the seepage and increases the liability of imperfectly-filled portions of the joints being covered by better compacted portions. They also give a greater body of cement to resist the action of the water reaching it before it is set, and allow of the mortar being placed within the joint instead of outside of it, which latter is of doubtful value in a trench where water is liable to reach it before it is set. The increased length of the joints adds very materially in preventing the pipe from moving in the joint, and thereby making a direct passage for the water into it. It, of course, requires more mortar directly in the joint, but it is doubtful if the waste of mortar is as great as in the narrow sockets. The amount of mortar required to make the different joints is given in Tables II., III., IV. and V., and also the approximate cost of the same per joint. In Table VI. the cost per cubic yard of various mixtures of cement mortar is given.

A gasket apparently increases the leakage by reducing the length of the joint, and thus the resistance to the passage of water. But in a very bad trench, where the water is likely to blow or wash the cement from the joint, it would prevent the sand from entering the pipe, and if thoroughly saturated in a grout of neat cement, might prevent the passage of water somewhat.

If the water, or a pressure of water, could be kept from the pipe for twelve hours, it would materially reduce the seepage, especially in the Rosendale cement.

It would seem to follow from the foregoing that Rosendale or Portland cement, either neat or mixed with sand in the proportion of 1 to 1 or 1 to 2, would make work that was sufficiently tight for all practical purposes, if the joints could be well filled and remain undisturbed by water or otherwise until sufficiently set to resist it. But the great advantage of the Portland cement is, that it will set in 1½ or 2 hours as firmly as the Rosendale will in 12 hours, this being about the proportion with the brands which were used in these tests.

The great trouble is to make good joints, largely, I think, on account of the shortness of the pipe, and this would dictate the use of 3 instead of 2-ft. lengths of pipe, which would reduce the number of joints 33%. If two joints of the pipe could be put together on the bank, and allowed to set 12 or 24 hours before laying, it would reduce the joints 50% again—that is, the joints to be made in the trench, and thus the liability of poor joints, for I am satisfied that a well-made joint, undisturbed until set, is good enough. But the difficulty in making the joints on the bank is in the alinement of the pipe. The ends are not square and true, and cannot be depended upon to give the proper alinement to it. I should like to try the experiment, or see it tried, of making a set of cradles of boards and plank, like the accompanying sketch, Fig. 14. In this the pipes could be given perfect alinement, and the joints made in advance of the work of trenching. If neat Portland were used, they could be removed from the cradle after 1½ hours, and with Rosendale they could be removed in four or five hours, and stood on end ready to be laid; it would be well to be 24 hours or more in advance of the laying. The joints could be nearly perfectly made in this way, and in about one-fourth to one-sixth of the time required in the trench, with less waste of cement. Then we should have 6-ft. lengths to lay, and a sufficient bell-hole and pump-hole could be dug, and a dam could be made across the pipe to hold back the water while a comparatively good joint could be made in the trench. It would be an experiment, of course, but I believe a successful one, and the pipe could be laid better, and even cheaper, than to make each joint in the trench. The expense of the cradles would not exceed $25 or $30 for enough to prepare pipe for laying 500 ft. per day, and one set of cradles would take pipe from 4 to 12 ins. and another set the larger sizes.

In these experiments no attempt was made to test different brands of cement. The cement that was used seemed to be of good quality, but was not tested in any way except in the joints and by a sieve; the sieve was 6,400 meshes to the inch, and retained 14% of the Portland and 28% of the Rosendale.

I am well aware that the results of these tests are only relative and not a positive indication of what would occur in the actual trench. For instance, the material in which the pipe was laid would largely affect the leakage into it, and other tests made under similar conditions to these might give entirely different results. This only claims to be a record of what actually took place under the given conditions, the tests being made with considerable care, and an attempt being made to record the results truthfully, uncolored by any preconceived theory. Others might interpret the results otherwise, but the opinions formed by the writer are the results of a study of the tests after they were all made, and of the impressions left upon his mind by the actual handling of the material, and they are offered in the hope that they may help a little toward some knowledge that will aid in overcoming, in part, at least, the infiltration of ground water. No tests were made of any other material than cement for the joints, as there seems to be at present nothing that promises to take its place. Tables II. to VI., inclusive, already mentioned, are computed from careful measurements, and may aid in the estimation of cost of sewer construction. The tables of cost will give a ready means of comparison of the cost of different mixtures of cement and forms of joints for a system of sewers.

GAGES FOR SHEET METAL, TUBES AND WIRE.

At the meeting of the American Railway Master Mechanics' Association at Saratoga in June, 1894, a committee was appointed to submit at the next annual meeting a method of ordering sheet metal, tubing and wire, by the decimal system, for the adoption by and use of the association, and a circular asking for information on this subject has been issued by the committee, as noted in our "Society Proceedings," in our issue of Dec. 27. The committee states that it is evident that nothing but confusion can result from the present practice of ordering by Birmingham, or Stubbs, Imperial Birmingham, American, United States Standard and other gages (often without making any reference to the name of gage in the orders), and it believes that if a system of ordering by expressing the thickness in decimals of an inch should be generally adopted, all trouble from this source would cease, and there could be no ambiguity. It further asks whether the following list of decimals would be sufficient:

Ins.	Birm'g gage.	Ins.	Birm'g gage.	Ins.	Birm'g gage.	Ins.	Birm'g gage.
.002	..	.022	24	.085	16	.125	11
.004	36	.028	22	.070	15	.135	10
.006	35	.032	21	.075	..	.150	9
.008	33	.036	20	.080	14	.165	8
.010	31	.040	19	.085	..	.180	7
.012	30	.045	..	.090	..	.200	6
.014	28	.050	18	.095	13	.220	5
.016	27	.055	17	.100	..	.240	4
.018	26	.060	..	.110	12	.250	3

The committee's circular is accompanied by a reprint of an article on the subject by Mr. Oberlin Smith, M. Am. Soc. C. E., from the "Iron Age," discussing the existing gages and showing their absurdity, and an abstract of this is given below, omitting the interesting tabular comparison of 13 American and 12 foreign gages.

We can scarce but admit the partial foolishness of that portion of the population who have been engaged at various times during a century past in the industry of inventing wire gages. In America, too, we find that either heredity or example, or both, has caused a further development of this pernicious industry, and that the crowning absurdity of all its products has been indorsed and legalized by no less eminent authorities than the two Houses of Congress and the President of the United States (Eng. News, Aug. 31, 1893). The measure referred to, which became a law last year, creates a new United States standard gage for measuring iron and steel sheets, which, instead of remedying the evils pertaining to the so-called wire gages, only intensifies them by adding a new set of arbitrary measurements to the numerous others already in use, by making these measurements more in-

expressible in terms of any known unit, and by giving them names more complicated than usual.

Criticising the law itself, the chief point that strikes one is its entire superfluity, its mission being merely to add another to the already too numerous gages which are based upon no scientific principle and are but poorly adapted to our practical wants. One of the chief points about this remarkable latest "standard" is that it is almost everything it should not be and fails to be almost everything that it should be, utterly ignoring many attributes that should be embodied in a good gage, some of which are as follows:

1. The popularity and universality which are necessary to secure definiteness of measurement in the commercial world.

2. Suggestiveness, preferably by making its unit of measurement in harmony with some other well-known unit, as, for instance, the English inch or convenient fractions thereof.

3. A logically progressive scale, with the smaller numbers for the smaller sizes, rather than a retrogressive one.

4. Uniformity of names or numbers, as, for instance, from unity upward, rather than mixing in a number of ciphers having no meaning in themselves.

5. A uniform or uniformly increasing increment in each successive size.

6. Adaptability to the convenient measurement of any substance, rather than with a limitation to a particular metal or a particular form thereof.

7. Simple and decimal fractions, rather than complicated vulgar fractions, when translated into the inch or other well-known units.

8. Capacity for additional sizes, either smaller or larger than the original ones or interpolated between the same, as requirements at first unthought of may afterward occur.

Another curiosity in the gaging business is to have no gage at all, as is the case in measuring tin-plate, whose thickness is commercially known by such names as Taggers when anywhere from .004 in. to .008 in.; as IC from .008 in. to .014 in.; as IX from .013 in. to .017 in.; as IXX from .015 in. to .019 in., etc. It will be noticed that these numbers lap each other in most cases, so that the same sheet might be called by either of two of the names given. There is, however, no attempt to measure this thickness, either by makers or users, it being guessed at by weighing a box of plates and knowing the number of sheets therein, these usually varying individually to a considerable degree in any one box. The sorting, which is generally necessary, is done by shaking each sheet flatwise and judging of the thickness by the stiffness and weight.

A supplementary set of sizes, lying between any of the gage numbers of any of the 25 gages mentioned, are in practical use, and are known by the following names: No. so-and-so easy, or bare or scant, or loose, or light; also, No. so-and-so full, or tight, or heavy. Still another set of sizes are represented by these same adjectives with the word "rather" as a prefix; and still another set by the use of fractions, No. 15½, etc., the ½ serving as a suffix to, and in some way modifying, a regular gage number. Furthermore, the people who use the above adjectives, with or without their qualifying adverb, and who use the fraction spoken of, do not generally make it very clear as to whether the scantness, or fullness, or increase expressed by the fraction refers to the actual size of the gage notch in question or to the numbers designated. Such indefiniteness in the case of retrogressive gages may of course reverse the meaning intended, and therefore the occupation of receiving and filling orders for sheet metal, rods, nails, rivets and wire becomes a somewhat puzzling one, to say the least. A customer merely states that it is to be No. so-and-so, qualified occasionally perhaps by the adjectives, etc., just mentioned, but says nothing about what gage is meant, and how the adjectives and fractions are intended to be applied, nor whether he is depending upon duplicating material which has been measured by some old gage with worn-out notches. This is no fancy picture, but merely a portrayal of some of the misery daily occurring in commercial life.

The subject is constantly attracting more and more interest among engineers and other scientific men, with a probable result of some definite standard methods of dealing with the measurements in question being settled upon in the not too-far-off future. Were it an Anglo-American question only, there would be but little difficulty in popularizing the Whitworth gage, this being, I think, the only logical system where the English inch is the unit of measurement for larger sizes. Such gages would be made not only for all varieties of sheet metals, wire, rods and bars, but for paper, cloth, leather, glass, etc., one system answering perfectly for all. The apparent unnecessary magnitude of a gage comprising every 1-1,000 in., say, from 1 to 1,000, can be easily overcome by preparing notched gages for particular trades and industries, containing only such sizes as are in common use therein. Each industry or group of industries needing about the same range could thus have as small and simple a gage as possible, with all superfluous numbers omitted; and any gage would absolutely agree with any other, whenever they happened to have any numbers in common.

The real difficulty in this matter, however, looms up when we attempt to contrive an international gage, which will be equally welcome to the peoples of the earth using the English inch and the French meter. It has been suggested that a gage founded upon a hundredth of a millimeter as a unit, each number to express the quantity of these units embodied, would answer perfectly well for the whole world's use, and this view is advocated by a number of scientists in this country as well as abroad. Such a scheme has the disadvantage for England, America and Australia of not being easily translated into and compared with our standard measurements. It has, however, the advantage of having a unit of about 1-2,500 in., which for very small sizes is better than the 1-1,000-in. unit of the Whitworth gage. Whichever of these two most feasible schemes may be adopted, the commercial and engineering world will certainly be happier and better therefor. One strong point in favor of the general principle herein advocated is that any of the notched gages (which form seems to be popularly demanded) founded thereupon can be easily calibrated and kept in order by the ordinary micrometers such as are now in use in all machine shops, measuring by thousands up to 1 in., or similar ones arranged for the metric system.

This very important subject is now being looked into by a committee of the American Society of Mechanical Engineers, which will probably co-operate with committees from the other great national engineering societies. Interesting discussions have for some years past taken place in the various society conventions, in one of which the adoption of a 1-1,000-in. unit for a numbered gage was proposed and strenuously advocated by the present writer, he at that time (May, 1889) being ignorant that Whitworth had previously done the same thing and also had put it in practical shape. Nobody appears to have ever seriously opposed this scheme, but there seems yet to be the inertia of a heavy mass of conservatism and indifference to overcome.

BRIDGE OVER THE TENNESSEE RIVER AT JOHNSONVILLE, TENN.*

This bridge is on the Nashville, Chattanooga & St. Louis Ry., and was built in 1886 by the Nashville & Northwestern Ry. Co. The cost of the substructure was $94,512, and of the superstructure $13,275. The first bridge was a Howe truss, built in 1871, designed for a moving load of 2,240 lbs. per lin. ft. The average depth of water was between 6 and 7 ft., except at the channel on the west side of the draw, which was 10 ft. The bed was composed of hard blue clay, cemented with iron pyrites. It was very smooth and nearly level lengthwise of the piers. The piers were built upon cribs of timber, roughly hewn, and towed to place, and the stone foundation laid roughly on them and grouted. The abutment on the east side is founded on rock. In 1890, the Superintendent of Bridges reported that the top of pier No. 7 had moved 1 ft. 7 ins. towards the round pier, and 200 carloads of rock had been thrown around it.

In the rise of water in 1882, a log house lodged against pier No. 9, and the pier settled eastward 4 ins., and down stream 8 ins. When the water fell it showed that five large stones at the north end had fallen out. These were replaced, and the cribs were sunk on the down-stream side, and large quantities of slag thrown around them. Since then the pier has settled 1 in. eastward, and 2 ins. down stream. Up to 1890, 843 carloads of rock in all had been thrown around the piers. On Oct. 25, 1890, two spans were blown away by a tornado, and were afterwards replaced.

Plans and estimates were presented in 1890 for a new structure, to cost $485,000, to consist of two 60-ft. plate girders, two 268-ft. and two 240-ft. river spans, one 375-ft. draw, and twelve 115-ft. and one 94-ft. shore spans. The shore piers to be made of iron shells filled with concrete and founded on piles, and the river piers to be of masonry founded on pneumatic caissons.

In the fall of 1892, the writer was appointed Chief Engineer. The process of undermining the piers was going steadily on, and the holes below the piers were increasing in depth. The deepest scours appear after the heaviest floods, and the current attains a velocity of 5 miles an hour. The gravel, which in light rises is washed from about and around the piers into the holes below, is by the heaviest rises and strong whirlpools formed below the piers, taken up and deposited on the islands below. Steamboat men complained of the narrowness of the channel and the danger to boats in passing through the draw, and the deposit of more riprap had been prohibited by the government. The heavy scour around the draw piers was evidently caused by the contracted channel, but with the exception of Pier 3, the scour was light elsewhere. No settlement had been discovered in Piers 7 to 9, and it was believed that if a good channel was provided for boats on the other side, no objection would be raised to riprapping around the other piers.

There was much difference of opinion as to how near it would be safe to locate the new piers to the old ones without causing disturbance. Examinations were made by driving a hollow iron pile to determine the depth of rock. The plan adopted contemplated the sinking of two foundations to bed rock, one for the pivot pier and one for Pier 7; the dredging of the channel to a depth of 8 ft. below low water, the carrying of the old spans while the work was in progress, the erection of a new draw and the removal of the old one and one fixed span, the renewal of the wooden members in the old combination spans; and, among other things, the rearrangement of lateral bracing and the raising of the entire bridge 4½ ft., so as to get it above the high water level of 1882. A plan was suggested for carrying the span resting on Pier 7, by lateral trusses 90 ft. long, resting on temporary pile piers. The pneumatic process and dredging through open wells were both suggested. The contracts were awarded April 28, 1893.

The pivot pier caisson was 36 ft. square and 16 ft. high, and the one for Pier 7 was 40 ft. 6 ins. by 16 ft. 9 ins. and 12 ft. high. Cribs filled with concrete rested on the caissons and extended to within 2 ft. of low water. The sides of the caissons were plumb, and a steel shoe was used on the cutting edges. For safety against floods, the pivot caisson was first sunk. An experiment of driving piles close to Pier 1 was tried, and eight piles were driven on the west side to a depth of 6 ft. About 12 o'clock that night the pier careened, the top moving westward 4 ins. and down stream 1 in., buckling the bottom chord of one of the spans and displacing the lifting gear of the draw. It was evident that this was not a safe procedure, and the carrying spans were at once erected and the old pier taken down nearly to low water before the sinking of the caisson was begun.

In sinking the caisson, owing to the weight of the old pier, it moved eastward about 2½ ft., 1 ft. of which had been provided for in locating it. This was corrected in starting the masonry upon the top of the crib, and when the cutting edge had finally reached the bottom the masonry was found to be 2 ins. too far up stream. When rock was reached it was found to be level. The sinking of the caisson disturbed the gravel around the pier very little, so that nearly all of the falsework piles used in the erection were left erect. As soon as the caisson was landed, piles were driven between the carrying trusses, forming a pier to carry the old spans. The supporting trusses were then removed to the site of Pier 7 and re-erected on new pile piers driven for the purpose. The trusses were found to be longer than necessary, and there had been considerable sagging on account of the greenness of the timber and the rough framing, and the end panels were therefore removed.

As soon as the weight of the old structure was transferred to the trusses the old pier was taken down, and a steam dredge was used for clearing away the riprap and old cribs. The sinking of this caisson and the completion of the masonry were quickly accomplished. The stone was set between the trusses by means of a traveler at the level of the top chord of the old bridge, which took the stone directly from cars standing on the bridge. This necessitated considerable night work to avoid interfering with traffic. Heavy frost caused some of the recently quarried stone to crack, but no stone cracked after setting.

The pressure house was placed on the shore at the end of the bridge and connected by pipes with the caissons. The pipes were not interfered with by the turning of the draw. In raising the draw the west end was raised first by a traveler working from the center, the staging and the removal of the old draw going forward also. The west arm was then raised and the draw turned for boats on Dec. 4. The trusses of the draw were erected in their true positions on the new drum, the cross-floor beams and bottom lateral bracing being left out entirely. The track on the bridge was then raised on the falsework to the new grade, and the floor system put in, the approaches, etc., being raised at the same time. No delays of any note occurred to traffic.

The removal of the pivot pier was quite difficult for the top 20 ft., as it had been grouted. Below this point the voids seemed to be filled with silt. The

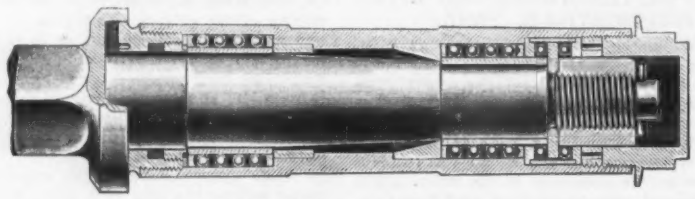
* Abstract of a paper by Hunter McDonald, Chief Engineer of the Nashville, Chattanooga & St. Louis Ry., presented at the meeting of the American Society of Civil Engineers on Jan. 2.

dredging was completed and the whole substructure plant removed by Dec. 20. The total weight of the draw, exclusive of the turning engine and gearing, is 734,800 lbs.

In topping out the old piers, bents were set up on each side of the pier, founded on riprap, and both spans carried on stringers thrown across the piers. The old coping was first removed, the wall put up and the coping put back. The spans are now, as formerly, carried on 2 ft. of timber on the tops of the piers. All the old piers were carefully pointed, in order that any settlement might be quickly detected. No cracks have as yet appeared. Wherever the raise in the approaches was less than 12 ins., it was accomplished by doubling the caps, but above 12 ins., additional brace piles were driven on each side, and the old piles spliced by setting blocks of cedar on them and cover jointing.

BALL-BEARING AXLES FOR WAGONS AND CARRIAGES.

One of the latest applications of ball-bearings is to the axles of ordinary road vehicles, where the conditions of service are much more severe than on the racing sulkies and very light pleasure carriages, on which they have been in use for some time. We show herewith a ball-bearing axle for this class of work, which has been recently put on the market. As seen by the cut, the diameter of the axle, just beyond the collar, is somewhat greater than across the square part of the bed, in order to provide the greatest possible strength at the point where axles most frequently break. This diameter extends as far as does the larger set of balls, and the axle then tapers until the place for the smaller set of balls is reached, when it again becomes cylindrical. At the end the axle is threaded for the axle nut, which binds a steel washer against the axle shoulder. Upon this washer revolve two rings of balls, which also roll against surfaces that are practically a part of the box. Side motion of the axle in the hub is thus prevented. Under the collar is a recess for a felt washer, which does not take the thrust, but excludes water and dust, being slightly compressed by the brass packing ring when the wheel finds its place on the axle. This ring is screwed into the inner end of the box and encloses a small felt washer, which further prevents the entrance of water and dust, and is held in place by a packing nipple. The packing rings are marked "off" and "nigh," to indicate upon which side of the vehicle each is to be used.



ANTI-FRICTION BALL-BEARING AXLE FOR VEHICLES.

Two sleeves are fitted on the axle, so as not to revolve and these provide a hardened rolling surface for the balls. These, with all the working parts of the bearing, remain in the hub when the wheel is removed from the axle. The outside box is of hardened steel and the balls roll between the sleeves and the inner face of this box. Each bearing has two radial cages, which contain the balls that support the direct weight of the vehicle. These cages keep the balls equidistant from each other and retain them in their proper positions. The entire set of balls can, therefore, be handled as one piece, which is a great convenience. The cases do not rub against any other part of the bearing, but rest upon the balls and are carried round by them with but little friction. The end-thrust case is composed of six parts, perfectly fitted together, but not screwed, The axle washer is bound against the shoulder of the axle by the nut and remains stationary. The other parts revolve, the balls rolling between the middle or axle washer and the two end-thrust washers. The whole case is held together and against a shoulder in the box by the holding ring, thus becoming practically a solid part of the box. A brass cap is screwed into the outer end of the box and bears against the holding ring. It acts as a check nut on the ring, and also serves to exclude water and dust from the outer end of the bearing.

The bearing is made by the Ball Bearing Co., of 33 India Wharf, Boston, Mass., under the patents of the late George F. Simonds, M. Am. Soc. M. E., who was the president of the company.

"The Currents of the Great Lakes" form the subject of a work written by Prof. M. W. Harrington, and published by the U. S. Department of Agriculture. With it are large maps of each of the lakes, showing the prevailing direction of currents as established by float experiments. These currents are grouped under the four heads of body or outflow currents, surface currents, due to prevailing winds, return currents and surf currents. The careful study and mapping of these currents will prove of much service to navigation, and will be useful in legal cases turning upon the direction and influence of these currents.

The last wreck chart published by the U. S. Hydrographic Office states that there is an annual loss at sea of 2,172 vessels, 1,200 lives and a money value of $100,000,000. To bad navigation is ascribed 10% of this loss of life and property, and another unknown percentage is chargeable to the unreliability of compasses in modern iron and steel ships.

The improvement of canals and inland waterways is being taken up in England, and it is found that many canals that have been acquired by railway companies have been allowed to become practically inoperative. The Sheffield & South Yorkshire Navigation Co. has recently been organized to acquire from the Manchester, Sheffield & Lincolnshire Ry. canals aggregating 57 miles in length, which are to be deepened and improved, and larger locks built to enable steam towing to be adopted.

Liquid fuel has been found very satisfactory on some of the locomotives of the Great Eastern Ry., England, and is now used on engines for express as well as for ordinary passenger and mixed trains. The arangements do not interfere with the use of coal in the ordinary way, the jets being introduced through the back plate, below the fire hole, and the front plate being protected by a firebrick lining below the brick arch. In operation the grate is kept covered with about 3 ins. of solid fuel (coal, coke, coke refuse, or a mixture of coal and chalk). The combustion of this solid fuel is checked by the dampers, a little fuel being occasionally added if the fire burns too thin. The oil fuel used is astatki, or the refuse from Russian petroleum, but coal and oil gas tars and creosotes can be burned with equal facility. One ton of such fuel is said to equal two tons of coal. The fuel is carried in cylindrical or rectangular tanks on the tender.

The British Aluminum Co. has recently been incorporated in London to acquire mines in the north of Ireland which will furnish ample raw material and to control the patents of Dr. Bayer and the Cowles Syndicate Co., and the factory of the latter company. Lord Kelvin, the new company's "scientific adviser," reports that the processes are well adapted for insuring commercial success, and legal opinions have been given to the effect that the company will control the manufacture of aluminum and aluminum bronze in the United Kingdom. The capital is $1,500,000.

A number of Nicaragua Canal shares are said to have been sold in England by Mr. John R. Bartlett, chairman of the stockholders' reorganization committee. According to press despatches from London, Mr. Bartlett reports the results of his visit as very satisfactory, and intends to return to New York very soon to organize a new construction company and to complete the arrangements for placing the securities.

A telegraph line constructed and operated under conditions of exceptional interest is that recently completed in Kashmir, in the far north of India. The line extends from Srinagar to Gilgit, 240 miles, crossing high ranges where deep snow and intense cold prevail, and traversing wild and desolate regions north of Gurais. The Rajdiangan and Burzil passes are, respectively, 11,600 ft. and 13,500 ft. above sea level, and the snow is sometimes from 10 to 14 ft. deep on the former and 16 to 18 ft. on the latter. The poles are 30 ft. long, and the use of braces is avoided, as the weight of snow upon them tends to throw the poles out of line. In sleet storms the wires become thickly coated with ice, and for this reason specially strong steel wires are used, carried on poles placed close together. To avoid landslips and snowslides, the line is placed high up along the sides of the valleys. There are four observation offices, equipped with ample supplies of clothing and provisions, and also with snowshoes for use by the men. The work has been carried out under the supervision of Mr. H. S. Olphert, of the Indian Telegraph Department.

Records of recent rapid work in shaft sinking at the New Primrose mine in the Witwatershed District in South Africa, have been furnished us. The shaft was 17 × 6½ ft. in cross-section and the work was carried on by three white miners using Ingersoll-Sergeant drills. The detailed record of work for 31 days is given as follows:

	Act'l time blasting and drilling. hrs.	No. of blasts.	No. of skips hoist'd.	Dynamite used, cases.	Distance sunk, ft.
1st week	63½	7	538	6½	38
2d week	63	7	532	6½	36
3d week	80½	9	609	8	43
4th week	71	8	580	12	34
3 days	37	4	315	7	14½
Total	315	35	2,634	40	165½

The skips held about 15 cu. ft. or three-fourths of a ton, making the total amount of rock removed about 1,975 tons. The total cost of the work was about $25.40 per ft. of depth.

The flying machine, or rather aeroplane, devised by Professor Langley, of the Smithsonian Institute, was lately tested at Quantico, Va., and after moving through the air for about 300 ft. it fell to the ground, owing to some imperfections in the mechanism. This machine was 12 ft. long over all and 8 ft. wide, measured across the front wings. There are four wings and a steering pair of wings in the rear, of about half the size of the others. These wings do not flap, but remain in a fixed position when soaring. The propelling power is steam, provided by a small copper boiler, and an engine placed in the aluminum body, which operates two small wooden propellers located at the end of the body. The wings can be moved to guide the course of the machine.

An Amsler compensating planimeter has been devised which can be adjusted to correctly read areas on a map shrunk in mounting or from other causes. It is the joint invention of Dr. A. Amsler, the son of the original inventor, and Mr. W. F. Stanley, of Great Turnstile, London. The correction for shrinkage in made by means of a short scale on top of the planimeter, divided into hundredths and reading by a vernier to thousandths of the length of the tracing area. The percentage of shrinkage is found by measuring the scale of the map by a true scale and then setting off double the percentage difference on the vernier scale from zero. Special vernier scales are required, and the following have been worked out and are for sale: 1-2500, 1-500, 6 ins., or 5 ft. to the mile, and 12 ins., or 10 ft. to the mile. These are especially prepared for reading shrunken English ordnance maps.

The use of high explosives, as a bursting charge in shells thrown by ordinary powder guns, is reported upon by the Ordnance Bureau. This bureau recommends further experiments before committing itself to any purchases. Two 7½-lb. charges of emmensite have been safely fired from a 7-in. rifle with 25-lb. powder charge, and two other charges of 106 and 111 lbs, respectively, have been fired from a 12-in. mortar with 20 lbs. of powder used. With the smaller charges, at 50 yds. range, the target was perforated without explosion. With the 12-in. mortar the range was 2,200 yds. and the shells buried themselves in the earth without explosion. What the bureau now wants to do is to convert an old 13-in. smooth-bore gun into a rifle, and fire from it 10 cast steel shells each capable of carrying 200 lbs. of emmensite. If these heavy charges can be safely fired it is thought that the high-explosive problem will be nearly solved, and an important use found for an obsolete gun. The Navy has fired from a 6-in. gun an 80-lb. projectile containing 11 lbs. of wet gun cotton. These shells were provided with dry gun-cotton primers and detonators, and while they exploded with tremendous violence in a hill-side, they made very little impression on a 7-in armor plate. On increasing the velocity from 1,400 to 1,800 ft. sec., one of these shells exploded in the bore of the gun. It was decided, however, that this was due to the fact that the walls of the shell were too thin and that this shell bulged under the pressure and its course was checked sufficiently to cause the primer and cap to fly forward and explode the charge. Experiments are now to be made with a 10-in. gun and a properly proportioned shell containing 70 lbs. of gun-cotton. Naval officers believe that such a charge can be safely fired with a muzzle velocity of 1,400 ft. per second.

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PERSONALS.

Mr. Geo. W. Aldridge, of Rochester, N. Y., has been appointed by Gov. Morton as Superintendent of Public Works of New York State.

Mr. Thomas J. Nixon, formerly Superintendent of the Cincinnati, Richmond & Fort Wayne R. R., died at Richmond, Ind., Dec. 24, at the age of 74.

Mr. Richard Gentry, Second Vice-President of the Kansas City, Pittsburg & Gulf R. R., has resumed his duties as Chief Engineer in charge of construction.

...r. Corbett, of Port Arthur, Ont., Can., one of the contractors on the Port Arthur, Duluth & Western Ry., was drowned in the Kaministiquia River, Dec. 17.

Mr. A. A. Allen, General Superintendent of the Missouri, Kansas & Texas Ry., has been appointed Assistant General Manager, and the former office has been abolished.

Mr. Sol. Palmer, Superintendent of Construction of the Western Union Telegraph Co., died at St. Louis, Mo., Dec. 25, at the age of 72. He built the first line out of New York in 1845.

Mr. J. M. Barr, Superintendent of the Breckenridge Division of the Great Northern Ry., has been appointed Superintendent of the Western Division, with headquarters at Spokane, Wash.

Mr. William Shannon, Superintendent of Bridges of the Adirondack & St. Lawrence R. R., was run over by a special train while riding on his handcar near Malone, N. Y., Dec. 24. He was fatally injured.

Mr. Louis Brown, City Engineer of New Orleans, La., has resigned, and Mr. H. W. Brown has been appointed to succeed him. Mr. Louis Brown was elected in 1892 for four years, and under him a survey has been made for the proposed drainage system.

Mr. G. Adovran and Mr. P. Kokolon, two engineers of the Siberian Railway, are visiting this country for the special purpose of inquiring into the merits of American locomotives and the systems of ferries and car transfer-boats for railway service.

Mr. Wm. J. Haskins, M. Am. Soc. C. E., has severed his connection with the C. W. Hunt Co., and has opened an office at 18 Broadway, New York city, for general engineering work, making a specialty of designing and contracting for the erection of all kinds of coal and ore-handling machinery and light railway supplies.

Messrs. T. C. Clarke, Octave Chanute, Wm. H. Burr, Charles Sooysmith (members of the American Society of Civil Engineers) and ex-Mayor Abram S. Hewitt, have been appointed by the Rapid Transit Commission to consider the report presented by Mr. Parsons, engineer of the Commission, which report was given in our issue of Dec. 27.

Mr. Robert M. Shotwell, civil engineer, of Brooklyn, N. Y., died Dec. 25, at the age of 73. He studied at West Point, but ill-health compelled him to leave before graduating. He served in the war as a private, and after the war engaged in business with his brother, Edward Shotwell, as civil engineers in Brooklyn. He was engaged on the construction of the Long Island, the Harlem and the New York & New Haven railways.

Mr. Theodore Cooper, M. Am. Soc. C. E., and a member of the government commission of expert engineers reporting on the proposed Hudson River bridges last September, has been engaged by the New York & New Jersey Bridge Co. to prepare general specifications for a six-track railway suspension bridge over the Hudson River. The span is not mentioned, but this will probably conform with the expressed views of the War Department. The declared purpose in preparing these specifications and plans is to obtain bids for construction.

Mr. Albert F. Noyes, M. Am. Soc. C. E., of Newton, Mass., has been nominated by the Governor of Massachusetts as successor to Mr. Harvey N. Collison, of Boston, as Metropolitan Sewage Commissioner. Mr. Collison's term expires Jan. 7. Mr. Noyes was for some years City Engineer in Newton, and is now Assistant Chief Engineer to the State Board of Health. He was born in Boston in 1850. In 1867 he became attached to the City Engineer's office in Newton, two years later he became City Engineer, and remained in that position for 17 years. He designed the system for surface drainage in that city, also the park system, and the boulevard. In 1893 he was appointed Assistant Chief Engineer of the State Board of Health.

Mr. James G. Fair, who made a fortune of $50,000,000 in gold and silver mining in California and Nevada, died at San Francisco, Cal., Dec. 28. He was born in Ireland in 1831, came to this country with his parents in 1843, and after receiving a business and scientific education in Chicago, went to California in 1849. He introduced improvements in quartz mills and chlorinating plants for treating gold ores. In 1867 he formed a partnership with John W. Mackay, James C. Flood and W. S. O'Brien and acquired control of a number of valuable mines. He was U. S. Senator for Nevada from 1881 till 1887.

Mr. Thomas Clapp Cornell, Civil Engineer, died at his home in Yonkers, N. Y., on Dec. 29. Mr. Cornell was born on Jan. 7, 1819 in Flushing, L. I. In 1823 he removed to Rochester, N. Y., with his father, Silas Cornell, who was a surveyor and civil engineer. In 1840, Thomas C. Cornell entered the service of the State of New York as an engineer on the Erie Canal enlargment, and had charge of work on the combined locks at Lockport. In 1844-46 he was in Canada as an engineer on the Lachine Canal and was later employed in the office of the Engineer of the Provisional Board of Public Works. In 1846 he went to Europe, but returned in 1847 to accept a position on the Hudson River Ry., and was the assistant engineer in charge of the division between Spuyten Duyvil and Dobbs Ferry. He located in Yonkers and for many years did all the surveying and engineering required in that village. In 1854, he was one of the founders of the Yonkers Gas Light Co. and was president of the company from 1857 until his death. He started the first newspaper in Yonkers, still surviving as the Yonkers "Gazette," and after this had passed into hands hostile to his interests, he established a second newspaper, which also survives as the Yonkers 'Statesman." He was prominent in politics, but never held office.

Col. Geo. E. Waring, Jr., M. Inst. C. E., who has been appointed Commissioner of Street Cleaning for New York city, by Mayor Strong, was born in Poundridge, N. Y., July 4, 1833. He was educated at College Hill, Poughkeepsie, and later studied agriculture with the late James J. Mapes. In 1854 he lectured upon agriculture in Maine and Vermont, and in 1855 he assumed charge of Horace Greeley's farm at Chappaqua. In 1858 he was appointed agricultural and drainage engineer of Central Park, New York city, and remained there four years. In May, 1861, he was made Major of the Garibaldi Guard, in the three months' campaign, and then raised in St. Louis six companies of the Fremont Hussars, afterwards merged into the 4th Missouri Cavalry, of which he was commissioned Colonel, and he served with his regiment throughout the war. In 1867 he settled in Rhode Island as the manager of the Ogden farm, and remained there until 1877, when he commenced practice as a drainage engineer. He was an expert and special agent in charge of the social statistics of cities in 1879, and has been a member of the National Board of Health since 1882. Among engineers he is best known for his advocacy of the separate system of sewerage, which he applied to Memphis, Tenn., after the yellow fever epidemic of 1878, and has since introduced into other places. He is a prolific and pleasing writer upon matters pertaining to sanitary engineering.

ENGINEERING SOCIETIES.

NEW ENGLAND WATER-WORKS ASSOCIATION.—The adjourned quarterly meeting will be held at Young's Hotel, Boston, Mass., Jan. 9. There will be a meeting of the executive committee at 10:30 a. m., and lunch will be served at 1 p. m. At the meeting beginning at 2 p. m., Mr. Dexter Brackett, of Boston, will give a brief talk upon "Water Supply Required for Steam Fire Engines." Mr. Geo. F. Chace, of Taunton, will speak upon "Eternal Vigilance the Price of Good Water," and other speakers will follow. In accordance with a vote passed at the last meeting, all members are requested to furnish the secretary with a detailed statement of the monthly consumption in their respective cities and towns during the past year.

R. C. P. Coggeshall, Secy., New Bedford, Mass.

CONNECTICUT ASSOCIATION OF CIVIL ENGINEERS AND SURVEYORS.—The annual meeting is to be held in the City Hall, Hartford, Conn., Jan. 8, commencing at 10:30 a. m. In the afternoon the following papers will be presented: "Norwich Water Works," C. E. Chandler; "Notes on Heavy Pipe Laying," R. A. Cairns; "Sewage Disposal Works at New Rochelle, N. Y.," J. K. Wilkes. Other papers have also been promised, and there will be an evening session, at which lantern slides of important work will be exhibited and explained. A. R. Wadsworth, Secy., Farmington, Conn.

IOWA SOCIETY OF CIVIL ENGINEERS AND SURVEYORS.—The seventh annual meeting will be held at the Board of Trade, Dubuque, Ia., Jan. 16 and 17. There will be reports of committees, and the following will be among the papers presented: "Shore Protection," C. R. Allen, Ottumwa; "Shaft Sinking and Equipment, with Reference to Comparatively Shallow Shafts," J. T. Beards, Ottumwa; "The Deep Well at Glenwood," Seth Dean, Glenwood. There will also be an exhibition of instruments and blanks.

Seth Dean, Secy.

ENGINEERS' CLUB OF PHILADELPHIA.—At the meeting on Dec. 15 Mr. John L. Gill, Jr., read a paper on "Boiler Explosions," presenting a table showing the energy stored in boilers of different types, dimensions and horse-powers, and the height to which this energy would throw the boiler, with its water, in an explosion. He described particularly the late explosion of 27 boilers at Shamokin, Pa. The paper was discussed by Messrs. Christie, Loss and Overn. Mr. Carl G. Barth read a paper on "The Principles of Calculus in a New Light." L. F. Rondinella, Secy.

COMING TECHNICAL MEETINGS.

FRANKLIN INSTITUTE, PHILADELPHIA.
Jan. 4. "Relation of Forests to the Surface of the Country," J. T. Rothrock. Secy., W. H. Wahl, 16 South Seventh St., Philadelphia.
ENGINEERS' CLUB OF PHILADELPHIA.
Jan. 5. Secy., L. F. Rondinella, 1122 Girard St.
CIVIL ENGINEERS' SOCIETY OF ST. PAUL.
Jan. 7. Secy., C. L. Annan, City Engineer's Office.
CIVIL ENGINEERS' CLUB OF CLEVELAND.
Jan. 8. Secy., F. C. Osborn, 721 Hickox Building.
NORTHWESTERN SOCIETY OF ENGINEERS.
Jan. 8. Secy., D. W. McNorris, Burke Building, Seattle, Wash.
NORTHWESTERN RAILWAY CLUB.
Jan. 8. Secy., W. D. Crosman, Ryan Hotel, St. Paul.
DENVER SOCIETY OF CIVIL ENGINEERS.
Jan. 8. Secy., F. Ed. King, 36 Jacobson Block.
INDIANA ENGINEERING SOCIETY.
Jan. 8, 9, 10. Annual meeting at the court house in Indianapolis. Secy., J. R. Brown, Frankfort, Ind.
CONNECTICUT ASSOCIATION OF CIVIL ENGINEERS AND SURVEYORS.
Jan. 8. Annual meeting at the city hall in Hartford. Secy., A. R. Wadsworth, Farmington, Conn.
NEW ENGLAND RAILROAD CLUB.
Jan. 9. Secy., F. M. Curtis, P. O. Box, 1576, Boston, Mass.
NEW ENGLAND WATER-WORKS ASSOCIATION.
Jan. 9. At Young's Hotel, Boston, Mass. Secy., R. C. P. Coggeshall, New Bedford, Mass.
ENGINEERS & ARCHITECTS' CLUB OF LOUISVILLE.
Jan. 10. Secy., G. W. Shaw, Norton Building.
ENGINEERING ASSOCIATION OF THE SOUTH.
Jan. 10. Secy., H. D. Ruhm, Nashville, Tenn.
ENGINEERS' CLUB OF ST. LOUIS.
Jan. 10. Secy., W. H. Bryan, Turner Block.
NORTHWESTERN TRACK AND BRIDGE ASSOCIATION.
Jan. 11. Secy., D. W. Meeker, St. Paul, Minn.
MONTANA SOCIETY OF CIVIL ENGINEERS.
Jan. 12. Secy., G. O. Foss, Helena, Mont.
ENGINEERS' CLUB OF INDIANAPOLIS.
Jan. 12. Secy., C. C. Brown.
WISCONSIN POLYTECHNIC SOCIETY.
Jan. 14. Secy., Geo. G. Mason, 144 8th St., Milwaukee.
ENGINEERS' CLUB OF KANSAS CITY.
Jan. 14. Secy., F. W. Tuttle, Baird Building.
CENTRAL RAILWAY CLUB.
Jan. 13. Secy., S. W. Spear, East Buffalo Iron Works, Buffalo, N. Y.
MICHIGAN ENGINEERING SOCIETY.
Jan. 15, 16, 17. Annual convention at Lansing, Mich. Secy., F. Hodeman, Climax, Mich.
COLUMBIAN ENGINEERING SOCIETY.
Jan. 15. Secy., W. F. Hart, Washington, D. C.
WESTERN RAILWAY CLUB.
Jan 15. Secy., W. D. Crosman, Rookery Building.
ASSOCIATION OF ENGINEERS OF VIRGINIA.
Jan. 16. Secy., J. H. Pilcher, Roanoke, Va.
IOWA CIVIL ENGINEERS' AND SURVEYORS' SOCIETY.
Jan. 16. Annual Meeting at Dubuque. Secy., Seth Dean, Glenwood, Ia.
AMERICAN SOCIETY OF CIVIL ENGINEERS.
Jan. 16. Annual meeting. Secy., Francis Collingwood, 127 E. 23d St., New York.
NEW YORK RAILROAD CLUB.
Jan. 17. Secy., John A. Hill, Temple Court, N. Y. City.
ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA.
Jan. 17. Secy., D. Carhart, Carnegie Library Building, Allegheny.
ENGINEERS' CLUB OF CINCINNATI.
Jan. 17. Secy., J. F. Wilson, 24 W. 4th St.
SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.
Jan. 17. Atlanta, Ga., Secy., F. A. Charniot, Macon, Ga.
CANADIAN SOCIETY OF CIVIL ENGINEERS.
Jan. 17. Secy., C. H. McLeod, 112 Mansfield St., Montreal.
ENGINEERS' CLUB OF MINNEAPOLIS.
Jan. 21. Secy., E. Nexsen, Kasota Block.
BOSTON SOCIETY OF CIVIL ENGINEERS.
Jan. 21. "The Use of Steel in Large Buildings," C. T. Purdy, Secy. 6 E. Tinkham, City Hall, Rooms, 36 Bromfield St.
TECHNICAL SOCIETY OF THE PACIFIC COAST.
Feb. 1. Secy., O. Von Geldern, 719 Market St., San Francisco.
WESTERN SOCIETY OF ENGINEERS.
Feb. 6. Secy., Thomas Appleton, Lakeside Bldg., Chicago.

NEW PUBLICATIONS.

WATER SERVICE AND FIRE PROTECTION OF THEATRES. A Paper Prepared for the Annual meeting of the New England Water-Works Association, held in Boston, in June, 1894. By Wm. Paul Gerhard, C. E., Consulting Engineer for Sanitary Works, 36 Union Square, East, New York city. Address the author. 8vo; pp. 46.

An abstract of this paper was presented in our issue of June 21, 1894.

CONTRACT AND SPECIFICATIONS FOR THE CONSTRUCTION OF SEWERS. By J. Leland Fitzgerald, Schenectady, N. Y. Published by the author. Paper; oblong 8vo.

These specifications have blank spaces left for names, dates, and other details, and it is thought that they will be useful in letting small contracts in towns which do not print specifications for extension work after the main system is completed.

HEALTH COMMISSIONER OF ST. LOUIS: Report for the year ending March 31, 1894. George Homan, M. D., Commissioner. 8vo; pp. 263; fine colored plates.

This volume contains, in addition to other matter, copies of the contracts for the collection and disposal of garbage, and colored plates, with tables, exhibiting the results of chemical investigations of the Mississippi River from the city water-works intake to the mouth of the Illinois River. These investigations were made by Mr. Wm. C. Teichmon, City Chemist.

NEW YORK STATE ENGINEER AND SURVEYOR: Report for the Year Ending Sept. 30, 1893. Martin Schenck, State Engineer and Surveyor. 8vo; pp. 464; illustrated.

Aside from the detailed account of the year's work and suggestions for the future, this volume contains the reports on the Genesee River storage project, which were published separately some time ago, and were noticed in our issue of Aug. 9, 1894. The main investigations for this project were made by Mr. Geo. W. Rafter, M. Am. Soc. C. E., and some experiments and discussion by him in this connection on concrete tests were noted in our issue of Nov. 8, 1894. The poor quality of the paper and binding of this volume does no credit to the State of New York nor its public printer.

TRADE PUBLICATIONS.

ELECTRICAL FITTINGS AND APPLIANCES.—T. J. Murphy & Co., 136 Liberty St., New York city 8vo; 22 sheets of cuts.

This is a set of sheets of drawings showing cuts of insulators, lamp brackets, switchboards, fuse boxes, cut-out boxes, rheostats and various minor fittings for electrical work, such as insulated bolts, binding posts, etc.

BALL-BEARING AXLES. The Ball-Bearing Co., 33 India Wharf, Boston, Mass. Paper; 12mo; pp. 8; illustrated.

These ball bearings are of the system patented by the late Geo. F. Simonds, in which the balls are carried in cages and roll between the exterior box and a sleeve on the axle. We illustrate this device on another page of this issue.

GRINDING MILLS. Frisbee-Lucop Mill Co., 136 Liberty St., New York city. 12mo; paper; pp. 35.

In the Frisbee-Lucop mill two rolls are driven by centrifugal force against the inner face of an annular die. The rolls are given a rotary motion by cylindrical drivers carried in a rotating disk, so that the rolls have a rotary motion around the axis of the die and each also revolves on its own axis. They are used for grinding phosphate, cement, ore, etc. The Cook wet mill is designed specially for wet pulverizing for gold and silver ores.

STEAM ENGINES AND BOILERS.—Atlas Engine Works, Indianapolis, Ind. Paper, 4to; pp. 52.

This is a handsomely illustrated catalogue of the self-contained engines and boilers manufactured by these works. It is stated that the firm has 9,000 of its engines and even a larger number of boilers now in service. The catalogue includes plain self-contained engines with throttling governors, automatic cut-off self-contained engines with balanced valves, and boilers of the horizontal tubular and locomotive types. The engines have single cylinders driving a crank shaft, the crank-pin being carried between two crank disks, and there is a belt wheel on each end of the shaft. The slide valve is at the side of the cylinder and is worked by an eccentric. Portable rigs are shown, having the engine mounted either upon or under the boiler. There are also plans and particulars of engine foundations and boiler settings.

PRESERVATION OF TIMBER. Otis Allen & Son, Lowell, Mass. Paper; oblong; 8vo; pp. 24.

This firm has a plant for treating timber by the kyanizing process (impregnation with corrosive sublimate or bi-chloride of mercury by steeping the timber), and the pamphlet deals with the advantages of timber preservation by this process. Kyanized timber has been used for fence posts, planking, bridge work, mill floors, etc., with very satisfactory results, and the Lowell & Suburban Street Ry. Co. used over 1,000,000 ft. of treated spruce timber in 1892 when changing its system from horse to electric traction. This timber is said to have been exceptionally rough after treatment. The kyanizing works are at Portsmouth, N. H., where the timber is piled in tanks or reservoirs of granite laid in Portland cement and coated with coal tar. The tanks have a capacity of 150,000 ft. of lumber. The price for treatment varies, but is now about $8 per 1,000 ft. B. M. for lumber and $1 per 1,000 for shingles, while additional charges of 25 cts. per 1,000 ft. B. M. are made for unloading and reloading lumber delivered by rail.

CONSTRUCTION NEWS.

RAILWAYS.

East of Chicago.

BLUE MOUNTAIN.—The Harrisburg, Pa., "Patriot" states that this railway between Harrisburg and Slatington is to be built and that in a letter to William M. Hain, of that city, local solicitor of the company, General Solicitor Wayne says: We are locating surveys and getting estimates prepared by our engineers, and as soon as we can get the right of way adjusted, we believe we are in a position to construct the road. This right of way delay has held us back, and we will not be able to commence construction work until spring. We expect to consummate some agreement mutually satisfactory with the Pennsylvania and the bondholders of the Pennsylvania, Poughkeepsie & Boston, by which we will have terminals at Harrisburg and Reading in the west, and Boston and New England in the east. We connect at Slatington with the Lehigh Valley and the Lehigh & Lackawanna, thus affording an outlet to Bethlehem, Easton and New York.

BURLINGTON AND HINESBURG.—Frank O. Sinclair, Ch. Engr., Burlington, Vt., has completed the final surveys for this railway from Burlington to Hinesburg, Vt., 12 miles, and the right of way will now be secured. It is expected to commence the construction about May 1.

CHICAGO & SOUTHEASTERN.—This railway, known as the Indiana Midland, was opened for regular traffic to Brazil, Ind., Jan. 1, and it is stated that the line will be extended to Muncie this year, 20 miles further.

CENTRAL OF NEW JERSEY.—A branch will soon be built from Tamenend, Pa., along the Catawissa Mountains, according to press reports.

DETROIT & MACKINAW.—Incorporated in Michigan as a reorganization of the Detroit, Bay City & Alpena; capital stock, $3,000,000; incorporators, A. J. Thomas, 100 shares; H. Coster, 19,400, and N. Gibbs, 100, all of New York; Don M. Dickinson and Frank Fletcher, of Detroit, 100 each; Geo. N. Crocker, Mount Clemens, Mich., 100 shares. The proposed extension of the line to Bay City, Mich., was noted last week.

LAC LA BELLE LUMBER.—This company has been organized at La Porte, Ind., to develop 100,000 acres of hard wood timber and agricultural land in Alger, Schoolcraft and Delta counties, Mich., and is reported about to build over 80 miles of railway. Pres., E. W. Scott; Vice-Pres., W. A. Martin; Secy. and Treas., R. E. Morrison. A. M. Ogle, of Indianapolis, and E. F. Michael are directors. The capital stock paid in is $270,000.

MIDDLETOWN & CINCINNATI.—Incorporated in Ohio Dec. 26 to build a railway between Middletown, Butler county, and King's Station, Warren county, O.; to be operated by steam or other motive power; capital stock, $200,000; incorporators, Paul J. Sorg, Middletown, O.; Frank H. Ray, T. C. Simpson, John Auer, W. L. Dechant.

MILLERSBURG, ASHLAND & GREENWICH.—Wm. Weaver, Shreve, O., writes us that surveys have been made and right of way secured to Jeromesville and that eight miles of the road is in operation. The projected length of road is 38 miles. This railway is being built by the H. B. Camp Co., of Akron, O., and was noted in our issue of Nov. 15. Ch. Engr., John H. Hall, Canton, O.

NEWPORT & SHERMAN'S VALLEY.—The Philadelphia "Times" states that the first consignment of rails for the Path Valley extension of this railway from New Germantown to Fannettsburg, a distance of about 24 miles, has arrived at Newport. Grading is far advanced, but it will take some time to complete the tunneling on the mountain dividing the two valleys. It is expected to complete the line next summer.

NEW YORK & NEW ENGLAND.—This company has petitioned for authority to lay an additional track and make other improvements, which include a new passenger station, at Rockville, Conn.

OHIO SOUTHERN.—Surveyors have been at work at Oregonia, O., according to reports in the Cincinnati "Enquirer," for a proposed extension from McKay's Station, on the old Grasshopper line, the C., C. & H. V. Ry., which has been abandoned for seven years, through Harveysburg, Henpeck and Oregonia to Lebanon. It is also stated that the company will either lease the Cincinnati, Lebanon & Northern from Lebanon, O., or purchase it, the latter being more than probable, as it is determined to get to Cincinnati. The work is being rapidly pushed. The bridge across the Miami River at Oregonia will be an iron structure, a quarter of a mile long and from 150 to 180 ft. in height.

QUEBEC & LAKE ST. JOHN.—Efforts are being made to secure a completion of this railway to St. Alphonse, Que.

Southern.

CHESAPEAKE, OHIO & SOUTHWESTERN.—Surveys have been made for a proposed cut-off from Calvert City to Mayfield. The distance is about 25 miles, and the line will save 16 miles over the present route between Louisville and Memphis. Engr., E. H. Bowser, Louisville, Ky.

GEORGIA.—A press report from Atlanta states that a corps of engineers has started from Lula, Ga., to survey a line to Cleveland, Dahlonega and on through the mountains to Knoxville, Tenn., a distance of 110 miles, and that the scheme is backed by Northern capitalists and Messrs. Baldwin & Co., of Savannah.

GEORGIA NORTHERN.—Incorporated in Georgia to build a railway from Pidcock, in Brooks county, by way of Moultrie to the northern border of Berrien county; capital stock, $150,000.

GUNTERSVILLE, PACIFIC & BLOUNTSVILLE.—Press reports state that the construction of this railway will soon be commenced. The route is from Guntersville, Ala., in the extreme northern part of the state, to Blountsville, 20 miles north of Birmingham, a distance of 100 miles.

LOUISVILLE & NASHVILLE.—Plans have been prepared for about 1,000 ft. of elevated track at Mobile, Ala., according to reports, to handle coal. It is stated that the work will be commenced at once.

MURFREESBORO & WOODBURY.—Press reports from Murfreesboro, Tenn., state that Dr. Thompson expects to commence work within 60 days on a railway to Woodbury.

PICKENS & WEBSTER SPRINGS.—Incorporated in West Virigina to build a railway from Pickens, Randolph county, to Addison, Webster county; capital stock, $200,000; principal office, Parkersburg, W. Va.; incorporators, J. N. Camden, Parkersburg, W. Va.; John Brannon, and A. H. Kunst, Weston, W. Va.; G. M. Whitescorver, Pickens, W. Va.; C. K. Lord, Baltimore, Md.

SAVANNAH & TERMINAL.—Incorporated in Georgia to build a railway to extend from Savannah three miles along the Hermitage River front; capital stock, $500,000.

Northwest.

CHICAGO, MILWAUKEE & ST. PAUL.—It is reported probable that this railway will be extended next year from Ashland to Cameron, Wis.

CHICAGO, OTTUMWA & WESTERN.—Incorporated in Iowa to build a railway through Marion county and westward to the Missouri River, according to reports; capital stock, $3,000,000; incorporators, A. A. McGarry, J. H. Anderson and D. G. Ratcliff, all of Indianola, Ia. J. H. Anderson is president, and A. A. McGarry, secretary.

EAST ST. LOUIS, PERRY & CHICAGO.—Incorporated in Illinois to build a railway from Jerseyville or Grafton to Bushnell, and extending through Jersey, Calhoun, Picke, Brown, Schuyler and McDonough counties, and possibly through Greene county; incorporators, James M. Piper, Chas. G. B. Drummond, John A. Porter, St. Louis; Frank L. Hall, George Wittman, Perry; C. B. Boltin, Milton, Ill.; capital stock, $500,000; principal office, East St. Louis, Ill.

RICE LAKE, DALLAS & MENOMINEE.—Press reports state that this railway, which was projected, partly constructed and abandoned in the spring of 1893, will be pushed to completion by a syndicate of Eastern capitalists. The line is now in operation between Rice Lake and Cameron, Wis., eight miles.

SHEBOYGAN, ST. PAUL & CENTRAL.—Work was commenced on this railway at Sheboygan, Wis., Dec. 26. The first shovel of dirt was turned by Mayor Gee's and speeches were made by leading citizens. The road will connect that city with the Chicago-St. Paul railway, and will be completed by July 1 next. Parties interested in this road are also connected with the Superior & Southeastern, noted last week.

SOUTHEASTERN COAL.—Press reports from Cheyenne, Wyo., state that this company will build a railway from the coal fields in the northeastern part of Wyoming, through South Dakota, probably to Sioux Falls; capital stock, $500,000; directors, John D. Parker, J. L. McKeener, Eugene Ellsworth, Egbert Chamberlain, and M. Nix; principal office, Aladin (not a post office), Crook county, Wyo.

Southwest.

CHICAGO & ALTON.—A correspondent writes us that T. B. Blockstone, Pres., states that the contract for the bridge at Jefferson City, Mo., has been let, and that this company will run passenger trains into that city by June 1, and into Springfield within 12 months. H. S. Draper, Ch. Engr., is now locating the line between Jefferson City and Springfield.

GAINESVILLE, McALESTER & ST. LOUIS.—The committee on Indian affairs has favorably reported a bill granting this company right of way for two branches through Indian Territory.

KANSAS CITY, OKLAHOMA & PACIFIC.—A bill has been favorably reported granting this company a right of way 100 ft. wide, with an extra strip of land 200 ft. wide and 3,000 ft. long each 10 miles for stations, through Indian Territory and Oklahoma. The proposed route is from Coffeyville, Kan., southwesterly through Pawhuska, Guthrie, Kingfisher, Okla., to Albuquerque, N. Mex.

OKLAHOMA CENTRAL.—This company has been granted a charter in Oklahoma, and it is stated that the construction will soon be commenced. The road was described in our issue of Dec. 20. Ch. Engr., Geo. H. Brett, New Ponca, Okla.

RIO GRANDE NORTHERN.—Press reports from El Paso, Tex., state that C. K. Heil (for C. Kleteli), of San Antonio, has the contract for building this railway. Ch. Engr., G. N. Marshall, El Paso, Tex.

WICHITA FALLS.—Burkitt, Burnett & Murphy are reported to have been awarded the contract for building this railway from Wichita Falls, Tex., to a connection with the Missouri, Kansas & Texas, a distance of 20 miles, and it is stated that the construction has been commenced. The Illinois Steel Co. has the contract for the rails.

Rocky Mt. and Pacific.

AMADOR.—Hugo A. Strong, Vice-Pres., 1 Broadway, New York, informs us that this railway is projected from Carbondale to Amador City, Cal., 12 miles, with extensions to Plymouth, to Sutter Creek and Jackson, and to Volcano; gage, 2 ft. The right of way is about all secured and the line roughly located; final survey now in progress. The first two contracts have been

let to Jay Gruis and F. Westover, Amador City, Cal., and grading is now in progress; contracts for rails, ties, and rolling stock are under negotiation. Bonds are now being sold and whatever amount not taken by the public will be subscribed for by the mining companies whose properties will be benefited by the road. Ch. Engr., J. B. Treadwell, 970 Center St., West Oakland, Cal.

OREGON PACIFIC.—Press reports state that this railway was purchased at auction Dec. 22 by A. B. Hammond and E. L. Bonner, of Missoula, Mont., who have agreed to build the Columbia River & Astoria road, as noted in our issue of Dec. 20. The Oregan Pacific is projected from Yaquina, Ore., to Boise City, Idaho, 000 miles, of which 142 have been built.

SAN FRANCISCO & LOS ANGELES.—Incorporated in California to build a railway from San Francisco to Los Angeles; capital stock, $20,000,000, of which $500,000 is subscribed and $50,000 paid in; incorporators, Frederick Homer, of Berkeley, Wm. H. Martin, W. H. C. Fowler, A. Judson and W. J. Behan, of San Francisco. Mr. Homer is the chief promoter.

SOUTHERN PACIFIC.—A press report from San Francisco quotes H. S. Huntington, of this company, as stating as follows: A track is now laid 71-10 miles south of San Luis Obispo. Dec. 31 it is expected to recommence tracklaying and lay uninterruptedly at the rate of one-half mile per day, to the north bank of the Santa Maria River, near Guadaloupe, a distance of 23½ miles from San Luis Obispo. In this 23½ miles there are four steel bridges on masonry abutments with spans of 90 and 100 ft., and at the Santa Maria River there will be seven steel spans, each 180 ft. The work of constructing the foundations for this bridge is very considerab.e and will require until some time in April to complete, at which time the bridge will be rapidly erected on the masonry abutments and the track completed into Guadaloupe in a few days thereafter. Guadaloupe is 24.7 miles from San Lu's Obispo.

TOWNSEND R. R. BONUS CO.—Incorporated in the state of Washington to promote the building of a branch line of railway to connect Port Townsend with some transcontinental railway; capital stock, $1,000; incorporators, A. R. Coleman, J. A. Kuhn, W. H. H. Learned, F. W. Hastings, J. B. Hogg, T. M. Hammond, Jr., and W. B. Dennis.

UNION PACIFIC, DENVER & GULF.—Press reports state that Frank Trumble, Receiver, will commence the construction within 30 days of the line between Pueblo and Trinidad, a distance of 92 miles, for which he has been authorized to issue $1,000,000 of receiver's certificates, as noted last week.

WEISER & IDAHO NORTHERN.—It is expected that the construction of this railway will be commenced in the spring. E. H. Mix, Ch. Engr., Weiser, Idaho, has completed the preliminary location for a distance of 44 miles from Weiser and has run preliminary angular lines for the remaining 58 miles to the Seven Devils copper district, which is claimed to be unexcelled in the world. The maximum grade for the first 64 miles will be 1½% and the maximum curvature about 10°. The first 75 miles will require only a little clearing of timber or brush, but the remaining portion of the route is heavily timbered. The road will probably be laid with 64-lb. steel rails and there will be three 200 to 250-ft. steel bridges, the remaining bridges being of wood.

Foreign.

MEXICO.—A press report from San Luis Potosi, Mex., states as follows: This city is to have direct railway connection with the Pacific Coast, a concession having just granted by the Federal Government to Marino Barcena, a well-known capitalist, for the construction of a road between this city and the port of Chomele. In addition to the main line, the concession calls for the building of branches to the towns Tegrula, Magdelina, Tequesquite, Ezolian, Ameca and Lagos. Work must be begun on the road within a year and the entire system must be completed and in operation within ten years. The building of this road will give Central Mexico a direct outlet to the Pacific Coast and will be of immense benefit to the commercial interests of the entire country.

MEXICO.—Press reports from San Juan Bautista, Mex., state that a number of railway enterprises of an important character are on foot in that section of Mexico, which at present is completely isolated for transportation facilities. Several concessions have been granted recently by the government for the construction of lines in that state. The most important of these is the one just granted Santiago Carter for a line from Casa Blanco and terminating at Boca Nueva. The road must be completed within two years. The general offices of the road will be located at San Juan Bautista.

HONDURAS.—The Honduras R. R. Co. was incorporated in New Jersey Dec. 28 to operate at Puerto Cortez, in Honduras, Central America; capital stock, $500,000; incorporators, Washington S. Valentine, Jas. B. Houston, J. Dobson Good, Jas. T. Worthington and Stillman Gray, of New York, and Chas. H. Johnson, Union, N. J.

STREET AND ELECTRIC RAILWAYS.

ORONO, ME.—It is reported that Geo. E. Macomber has been awarded the contract for building the Bangor, Oldtown & Orono St. Ry. The other bidders were Pierce & Miller Engineering Co., New York; A. F. Gerald, and the Worcester Construction Co.

SKOWHEGAN, ME.—Press reports state that this place has voted to grant the right of way to the Skowhegan, Madison & Athens Ry. Power Co., to locate and construct an electric railway from the junction of Water and Madison Sts. up Madison St. to the town line.

HAMPTON, N. H.—A Chicago syndicate is reported as investigating the vicinity of Hampton beach, and as considering the advisability of connecting Hampton and Exeter with an electric railway.

MANCHESTER, N. H.—It is reported that contracts have been signed with the General Electric Co. for 40 motors for the proposed electric railway.

HINGHAM, MASS.—E. L. Ripley, C. B. Barnes and P. B. Bradley have made a proposition to the Hingham Electric St. Ry. Co. to increase its capital stock from $45,000 to $100,000, and have agreed to subscribe the necessary $55,000, according to press reports.—The company will probably be granted a franchise in this town.

BRISTOL, CONN.—The Bristol & Plainville Tramway Co., has petitioned for a franchise to construct its line on Broad St. from Main St. in Forestville to Poland Brook.

MILFORD, CONN.—The Connecticut Traction Co. has petitioned for a franchise for an electric railway from this place to Stratford, Bridgeport, Merwin's Point and Meadow's End. The line appears to be a project in opposition to the schemes of the Bridgeport Traction Co., which has also asked for about the same charter rights, according to reports. J. D. Brown, J. W. Thompson and S. H. Baldwin are interested.

NEW BRITAIN, CONN.—Press reports state that the Central Ry. & Electric Co. has finished the plans for the construction of its line to Hartford. The right of way has been secured from every person along the proposed route, with only one exception. The extension of the electric road will necessitate the construction of three bridges. The first bridge will be built over the New England track within the city limits, as soon as the city grants the company the right of way to extend its line from East Main St. to the city line. The second bridge will be constructed over the Consolidated road and the third over the railway near the mill pond in Newington. The bridge over the Consolidated road will be made of iron with a 60-ft. span, rising 20 ft. above the track. The contract for its construction has been awarded to the Berlin Iron Bridge Co., at $4,000. The company expects to have the entire work finished before next September.

ROCKVILLE, CONN.—It is reported that the Rockville, Stafford & Southbridge Tramway Co. will petition the legislature for an amendment to its charter, which will authorize the building of a branch electric road from the main line to Tolland St.

THOMPSONVILLE, CONN.—The Enfield & Longmeadow Electric Ry. Co. is reported about to petition for a franchise to extend its line to Windsor Locks and East Windsor.

BROOKLYN, N. Y.—E. B. Gallaher, Ch. Engr., Brooklyn, Newtown & Bowery Bay Ry. Co., 253 Broadway, New York, writes us that this line will have about 11 miles of double track and that about 60 cars will be operated in the summer.

COHOES, N. Y.—It is reported that bids will soon be received by the Cohoes City Ry. Co. for the construction of its line.

FLUSHING, N. Y.—The Flushing & College Point Electric Ry. Co. has been incorporated with a capital stock of $125,000; directors, Daniel Odell, E. B. Halstead, F. A. Dillingham, C. S. Kellogg, and others of New York.

LAKE GEORGE, N. Y.—Press reports state that a company has been incorporated with a capital stock of $150,000 to construct a cable railway to the summit of Mount Ferguson. The road will be a single track, with a switch in the center. The length of the road will be 7,500 ft., with 800 ft. of trestle work. The station on the mountain top will be 1,800 ft. above Montcalm St. and 2,100 ft. above the lake. There will be two cars, each with a capacity of 60 persons, and trips will be made every 10 minutes. It is expected that the road will be completed about June 1.

NEW BRIGHTON, N. Y.—The Staten Island Interior R. R. Co. has been incorporated to construct a street railway 15 miles long, in and between New Brighton, Edgewater and other villages in Richmond county; capital stock, $300,000; directors, Herman Bergholtz, D. F. Van Vleet, F. C. Cornell and Daniel Thomson, Ithaca; D. F. Evarts, New York, and C. F. Timson, New Brighton.

NYACK, N. Y.—The Nyack Traction Co. has been incorporated with a capital stock of $50,000 to build an electric line from the steamboat dock to the West Shore station at West Nyack. B. B. Odell, Jr., Pres. Newburg Electric Ry. Co., and F. B. Bain are interested.—The River & Valley Traction Co. has been incorporated by Harrison Bailey and Luddock Bros., and has engaged James S. Haring to prepare a report on the location and cost of constructing an electric road from Hook Mountain to West Nyack. All preliminary steps for building the road are being pushed. The Nyack Traction Co. is also securing signatures of property holders for its proposed line. The fight will not be carried further than the obtaining of a franchise from the village trustees.

PAINTED POST, N. Y.—The Corning & Painted Post St. Ry. Co. has been granted a franchise in this place and Corning. Pres., Edward Shedd, Worcester, Mass.

PORT RICHMOND, N. Y.—We are informed that A. S. Prall is getting consents instead of making surveys for the projected railway of the Thomas syndicate, as stated in the daily papers and in our item of last week. No surveys or plans for the road will be made before spring.

SAYVILLE, N. Y.—Press reports state that the citizens are considering the question of organizing a company to construct an electric railway from Sayville to Bohemia, Ronkonkoma, New Village, St. James and terminating at Port Jefferson. Those favoring the plan propose to buy large tracts of land through which the line will be extended, and then open up building lots for sale. And in connection with the electric plant, which will operate on the road, the village may be furnished with electric lights. The places to the east and west of Sayville are agitating similar enterprises.

MILLBURN, N. J.—The township committee is considering the question of granting a franchise for an electric railway between this place and Springfield.

TRENTON, N. J.—Press reports state that the newly-incorporated Trenton Traction Co., which for several months has been negotiating for the lease of the Trenton Electric Ry., has acquired control of the system by purchasing the 10,000-share interest of Col. Lewis Perrine, paying, it is said, $500,000 for the block. Pres., Thomas C. Barr, Newark; Secy. and Treas., John L. Kuser, Trenton; Gen. Man., Henry Moore, Philadelphia.

WOODBURY, N. J.—It is reported that early next spring the Camden, Gloucester & Woodbury Ry. Co. will extend the Almonesson branch to Blackwood, thence making a circle to Wenonah and connecting with the Mantua branch. About the same time work on the Mullica Hill branch will begin.

BRYN MAWR, PA.—Press reports state that petitions are being circulated asking the supervisors of Lower Merion township to grant a right of way to the Philadelphia & Rosemont Passenger Ry. Co., on the Haverford road and along the county line road, between Delaware and Montgomery counties. This company proposes to build an electric line from Philadelphia to Rosemont very soon, and afterwards extend it from Rosemont to Bridgeport. Additional petitions are being presented to the property holders asking for the right of way for the extension, which is to follow the Roberts road from Rosemont to the Gulf road on it to Bridgeport. The right of way has been granted in Haverford and Radnor townships, Delaware county, and Upper Merion township, and the borough of Bridgeport, Montgomery county.

CORRY, PA.—The construction of an electric railway is being agitated.

GREENSBURG, PA.—Press reports state that Col. F. Y. Clopper, Man. Greensburg & Hempfield St. Ry. Co., is reported to have said that this electric line would soon be extended to Jeannette. Nearly all of the right of way has been obtained. This is considered a beginning of electric railway communication between Greensburg and Pittsburg.

LANGHORNE, PA.—Some citizens of this place are interested in the building of a proposed electric railway from Bristol to Newtown, and have secured the option to purchase within three months the charter recently granted for such a road. If the scheme receives the proper indorsement, a line will be constructed in the spring from Hulmesville to Langhorne. H. W. Watson and Dr. Henry Lovett are securing subscriptions to the stock, according to reports.

READING, PA.—The Reading Traction Co. is considering a scheme to construct an electric line from a point on the Berks and Dauphin turnpike, east of Stouchsburg, through Sheridan, Millback and Kleinfeltersville to Schaefferstown, seven miles east of Lebanon. Pres., John A. Rigg; Solicitor, R. L. Jones.

BALTIMORE, MD.—The Edmondson Ave., Catonsville & Ellicott City Ry. Co. has been granted a franchise to construct a double-track electric line on Edmondson Ave. Pres., George Yakel.

BALTIMORE, MD.—A press report from this city states as follows: The first railway in the county to substitute electricity for steam will be the Baltimore & Lehigh (the old Maryland Central), which is now being extended to York, Pa. President Houseman, of the newly chartered Susquehanna Electrical Co., which proposes to harness the power of the Susquehanna River at Conowingo Falls, is prominently connected with the Baltimore & Lehigh R. R. Co., as are also Winfield J. Taylor and J. S. Bull, directors in the Susquehanna Co. This railroad alone would require a current representing several thousand horse-power. Its route is seven miles from the proposed site of the dam.

HAGERSTOWN, MD.—A company has been organized to construct a street railway in this place. Pres., C. M. Futterer; Vice-Pres., Chas. Webb; Secy. and Treas., G. H. Smith.

OAKLAND, MD.—It is reported that a charter has been issued for the erection of a large flour mill at Loch Lynn Heights. The incorporators intend to operate an electric light plant, and there is some talk of building an electric railway from Oakland through Mountain Lake Park to Deer Park, to be in operation during the summer season.

WASHINGTON, D. C.—The East Washington Belt Line Ry. Co. has petitioned for a charter; capital stock, $50,000. Calderon Carlisle, M. I. Weller and R. M. Larner are interested.

CRESCENT CITY, FLA.—It is reported that a street railway is to be built at this place.

NEW ORLEANS, LA.—The police jury is considering the question of granting a franchise for a railway from Carrollton to Kenner. L. H. Marrero, Pres. Com.

BEDFORD, O.—The Akron, Bedford & Cleveland Electric Ry. Co. has been granted a 25-year franchise in this place.

BUCYRUS, O.—It is reported that work on the Bucyrus & Galion Interurban Electric Ry. will be commenced by May 1. The line will be 13 miles in length, and, with a power house midway between the two cities, is estimated to cost $160,000. Pearl & Hussey, Pittsburg, Pa., are said to be interested.

YOUNGSTOWN, O.—Press reports state that the Poland Ry. Co., noted last week, has petitioned for a franchise from the county commissioners, and it will likely be granted. An electric railway to Hubbard, eight miles east, is also being discussed. Z. P. Curry, ex-County Clk., is interested.

FRANKLIN, IND.—The citizens of this place, Columbus and Greenwood have voted to subscribe $34,000 to aid in the construction of the Indianapolis, Greenwood & Franklin Ry. Co.'s proposed electric line from this city to Indianapolis, by way of Southport and Whiteland, a distance of 20 miles. It is thought that work will soon be begun and the line completed by June. Grafton Johnson and J. T. Polk, Greenwood, are interested.

INDIANAPOLIS, IND.—W. L. Taylor and L. C. Walker, representing the Broad Ripple & Indianapolis Rapid Transit Co., have petitioned the board of public works for an extension of time in which to complete the construction of the proposed railway.

VENICE, ILL.—Jenks, Meyer & Co., St. Louis, have petitioned for a franchise to build an electric line from this place to Madison and Brooklyn. The council of Brooklyn has granted a franchise to the same company, and it is proposed to continue the line to East St. Louis and from Madison to Granite City.—The Madison County Ferry Co. has petitioned for a franchise to build an electric railway to Madison to connect with the ferry.

NAUVOO, ILL.—The construction of an electric railway from this place to Fort Madison, Ia., or Keokuk is being discussed.

OREGON, MO.—The citizens are discussing a proposition submitted by a company that wishes to build an electric railway to connect this place with Forest City. N. F. Murray is reported as able to give information.

ST. LOUIS, MO.—The Clayton & Delmar Ave. Ry. Co., which is now building an electric line, has lately secured a franchise to build from Clayton to Creve Coeur Lake. It is the purpose of this company to build an electric plant at Clayton to furnish power for its railway lines and also to furnish electric lights for public and private use in the towns through which the roads pass. Pres., M. B. Greensfelder. The Lindell Ry. Co. is to extend its Chouteau Ave. electric line to connect with the Houseman Air Line, and it is probable that an electric line will be in operation by the end of the year between Kirkwood and St. Louis. Right of way has been secured for branch lines from Kirkwood to Des Peres; from Edgebrook to Clayton, and a new survey has been made by Mr. Houseman, at the request of the interested property owners, who have agreed to guarantee a private right of way for a branch line running southward from Forest Park through Benton, Ellendale, Maplewood, Frazier Park, Greenwood and Harlem Place, to Lindenwood, crossing the Missouri Pacific and Frisco railroads below grade. Although the right of way is not guaranteed beyond Lindenwood, it is probable that the line will be extended as far as Shrewsbury and Old Orchard.

UNION, ORE.—The persons who recently purchased the local railway have incorporated the Union St. & Suburban Ry. Co. The new company will operate the railway for hauling freight and passengers and will operate the telegraph line as heretofore. It also intends to extend the road from Union to the fertile section known as Cove, nine miles northeast of this place, and also to Eagle valley, by way of the extensive timber belt southeast of this city. Pres., Jas. Hutchinson; Vice-Pres. and Gen. Man., Nelson Schoonover; Secy. and Treas., James Raymond.

SAN FRANCISCO, CAL.—Press reports state that Wm. H. Mills, land agent of the Southern Pacific Co., says that the construction of an electric railway from Merced to the Yosemite Valley, a distance of 100 miles, is an assured fact. The capital stock will be $2,500,000, and will be taken mostly by Chicago capitalists. The right of way from Merced to Yosemite has been obtained, and it is claimed that contracts have been secured for the rental of electrical power for the use of mining at points on the road and for machinery at Merced exceeding $100,000 per annum. The power houses are to be established at three points on the Merced River. The road will be broad gage, and will serve the region for freight and passengers. The Pacific Improvement Co. will take the contract for the construction of the line. A. F. Hatch, Chicago, Ill., is interested.

PHOENIX, ARIZ.—J. C. Dobbins has been granted a franchise to build an electric railway from Church Hill addition into the Montgomery addition.

OSHAWA, ONT.—M. J. Butler, Engr. Bay of Quinte Ry. & Navigation Co., Deseronto, writes us that he has filed plans for the Oshawa Ry., which is to be operated by electricity. The line will be standard gage, seven miles in length, and will be built from the harbor on Lake Ontario to the Grand Trunk Ry., and thence to Oshawa, with branches to each of the factories. The line is to be completed by June 15.

PONTIAC, ONT.—The Quinze Electric Ry. Co. has applied for incorporation to build a line to Quinze. John Bryson, Pontiac, is interested.

ELECTRIC LIGHT AND POWER.

ATHOL, MASS.—The Athol Gas & Electric Co. is reported as having decided to put in an incandescent light plant in the spring and to furnish power for manufacturing purposes. Pres., G. C. Moses.

ARLINGTON, MASS.—A committee of seven has been appointed to inquire into the advisability of the town putting in its own electric light plant.

BLACKSTONE, MASS.—Press reports state that the taxpayers have voted to offer the Woonsocket Electric Light Co. a contract to light the town at 40 cts. per light per night, which proposition will probably not be accepted, and that if not accepted the town will put in an electric light plant of its own. The town is now lighted by the Woonsocket company. There are 29 lights, widely scattered. The rate is 50 cts. per night for each 2,000-c. p. light, each light to burn all night.

WORCESTER, MASS.—It is reported that the company which recently bought the Worcester Electric Power Co.'s plant is considering an increase in the capacity of the plant from 100 to 300 HP. Pres., M. F. Wrenn, Springfield; Treas. and Gen. Man., E. F. Carpenter, Concord, N. H.; Supt., J. J. Welch.

ALBANY, N. Y.—According to reports the council is considering the advisability of owning its electric light plant. It is estimated that a plant of 600 lights could be constructed for $200,000, and it is stated that the city now pays $144 per light per year.

ADDISON, N. Y.—An incandescent system will soon be added to the electric light plant, according to reports.

DELEVAN, N. Y.—The lighting of the streets with electricity is being discussed.

ATHENS, PA.—It is reported that the construction of an electric light and gas plant is being discussed.

BERWYN, PA.—This place is discussing the question of establishing an electric light plant.

HALLSTEAD, PA.—The lighting of this place with electricity is being discussed.

LIGONIER, PA.—It is reported that an electric light plant is contemplated.

WRIGHTSVILLE, PA.—The Conewago Light & Water Power Co. has made arrangements for lighting this place with electricity if the town will make a contract. The company proposes to extend its service through the counties of York, Berks, Dauphin, Cumberland, and Lancaster.

YORK, PA.—The York Haven Water & Power Co. is soon to apply for a charter to supply York and Goldsborough with water and power from the Conewago Falls, 10 miles distant from this city. It is estimated that from 40,000 to 60,000 HP. can be obtained. This company is in no way connected with the Conowingo or Conewago water and power companies recently incorporated. Henry L. Carter, Pres. York Haven Paper Co., and W. F. C. Stewart, of York, are interested.

ANACOSTIA, D. C.—It is reported that preparations are being made for the completion of the electric plant, which is to cost $22,500, and which has been partly constructed.

ARCADIA, FLA.—F. H. Jeannin, St. Louis, Mo., is interested in a scheme to put in an electric light plant.

WHITE CASTLE, LA.—The construction of an electric light plant is being discussed, according to reports. G. M. Bowie, Mayor.

HENDERSON, KY.—The question of an electric light plant continues to be discussed, according to reports.

MIDDLETOWN, O.—The contract for building the new electric light plant has been awarded to Wm. Caldwell, at $4,375, the other bidders being Denny & Simpson, $4,525, and Chas. Margerum, $4,744. Work will be commenced at once.

ANNAPOLIS, IND.—The Annapolis, Brighton Beach & Bay Ridge Electric Ry. Co. has applied for a franchise.

CAPAC, MICH.—Press reports state that the citizens are beginning to agitate the question of lighting the streets by electricity, and they desire to hear from reliable parties as to the probable cost of putting in a plant.

FRANKFORT, MICH.—It is reported that this place is to have an electric light plant.

GRAND RAPIDS, MICH.—Bids are asked until Jan. 7 for furnishing 380 arc lights of 2,000 c. p. each for a term of three years; 160 lights to be placed on 40 towers and 220 lights on mast arms or cables suspended across the streets. The towers are to be 150 ft. high. Jas. Emmer, W. T. Johnston and O. A. Ball, Com. on Lamps.

OTSEGO, MICH.—A committee has been appointed to confer with Nevins Bros. relative to putting in an electric light plant and lighting the village. M. O. Brockway, Clk.

PLAINWELL, MICH.—The board has made a proposition to G. C. & B. A. Nevins about lighting this place with electricity, according to reports.

LEMONT, ILL.—Porter & Covit, Joliet, are interested in a project for putting in an electric light plant. It is proposed to extend the system later to Mokena. Rathje & Jurz are interested.

LA CROSSE, WIS.—Press reports state that it has been talked at West Salem for some time that La Crosse persons were negotiating with S. D. McMillan for the purchase of his water power at Neshonoc, to be used in developing electric light for transmission to La Crosse or elsewhere. The deal failed because the price could not be agreed on. Since that time an option has been secured on another water power lower down the river.

HAMILTON, MO.—It is reported that this place is discussing an electric light plant.

OREGON, MO.—A company has submitted a proposition to the citizens to put in an electric light plant and electric railway. James Cummings, Mayor.

SEATTLE, WASH.—Arrangements have been completed by D. H. Gilman for the transmission of 1,000 HP. from the Snoqualmie Falls to the proposed car works on Salmon Bay and 5,000 HP. to this city by the Snoqualmie Falls Electric Power Co., which has lately been organized. The contract for the electrical machinery will probably be awarded to an eastern firm in about 30 days, and it is likely the plant will be in operation by October. It is reported that $3,000,000 will be invested in the proposed plant and the steel and car works.

SALT LAKE CITY, UTAH.—Charles Boeticher, Denver, Colo., has purchased the franchise granted to F. S. Walker in 1893 for an electric light and gas plant. Work on the plant, which is to cost $300,000, will commence at once. Poles and wiring have been purchased and are now being put up.

STRATFORD, ONT.—It is reported that the citizens will soon vote on the question of putting in an electric light plant to cost $16,000.

LOCKEPORT, N. S.—The question of lighting the town with electricity is being discussed.

NEW COMPANIES.—Winooski Electric Light & Power Co., Winooski, Vt.; E. R. Crandall, Dr. O. W. Peck.

Rushville Electric Light Co., Rushville, Ill.; $12,500; C. W. Wainman, C. B. Griffith.

King Solomon Mining & Power Co., Chicago, Ill.; $1,000,000; John Cassleman, A. B. Lewis, H. C. Igel.

Acme Electric Co., East Palestine, O.; $10,000; Geo. E. Sebring, R. N. Chamberlain, D. H. Mackintosh.

Columbia Illuminating Co., Columbus, O.; $25,000; R. J. M. Dauley, E. H. Zurhorst, W. D. Park, C. A. Field.

Southampton Electric Light Co., Southampton, N. Y.; $5,000; W. H. Vanbrunt, Southampton; Daniel Vail, Riverhead.

Mutual Electric Light Co., San Francisco, Cal.; $500,000; T. R. Henshelwood, J. B. Halsed, C. C. Dow, Irving Marshall.

Spring Motor Co., Dixon, Ill.; $150,000; to manufacture sewing machines and motors; W. M. Boolt, Robert Ryan, J. V. Paulson.

American Heat & Light Mfg. Co. of New Jersey, Trenton, N. J.; $100,000, with $1,000 paid in; to manufacture and erect machinery for furnishing light, heat and power; Francis M. Gardner, E. B. Fulper, Trenton; Alexander Gray, Camden; Theodore H. Bishop, Philadelphia.

BRIDGES.

SOMERVILLE, MASS.—Councilman-elect George E. Whitaker states that extra efforts should be made toward getting bridges over the Fitchburg R. R. crossings on Somerville Ave., and the Boston & Maine crossing on Washington St., just beyond the Charlestown line.

ESSEX, CONN.—It is stated that a new drawbridge is to be built in the spring to take the place of the one spanning the North Cove Bay, which was built in 1815.

BUFFALO, N. Y.—The notice of intention to erect an iron bridge over the Scajaquada Creek on Niagara St. has passed the aldermen. The bridge will cost $8,300 and it is proposed to meet the cost by an issue of bonds.

ELMIRA, N. Y.—The committee on bridges has recommended that bonds not to exceed $115,000 be issued for two new bridges over the river. When the bill is passed by the legislature, it will be submitted to the citizens at a special election.

ROCHESTER, N. Y.—The New York Central & Hudson River R. R. Co. has submitted plans to the council for a bridge and subway at University Ave., the work of building the subway to be commenced by the company by April 1.

PHILADELPHIA, PA.—Wm. H. Brown, Ch. Engr. Pennsylvania R. R. Co., writes us that the contracts for the masonry for the bridges over the Philadelphia & Trenton yard tracks, over Wheatsheaf Lane and Sepviva St., and over Luserne and Tulip Sts., have been let to P. McManus, of Philadelphia. The contract for all of the pile work required on the trestle approach to the Delaware River bridge has been let to Armstrong & Printzenhoff, of Philadelphia. The timber for the temporary trestle will be furnished by the railroad and framed and erected by the carpenter force belonging to the company, under Andy Brann, foreman. The contract for the masonry for the River bridge has been let to Drake & Stratton. The superstructure will not be awarded for some weeks. The contract for the masonry on eastern approach to the river bridge, as well as the bridge over the Camden & Amboy R. R. in New Jersey, has been awarded to C. A. Sims & Co., of Philadelphia.

PITTSBURG, PA.—Local papers state that the grand jury has approved the reports of viewers in the matter of a bridge over Pine Creek in McCandless and Hampton townships, and has recommended that it be erected at the county's expense. Reports of viewers on the following bridges were also approved: Campbell's run, Shaler township; Lewis run, Jefferson township; Moon run, Robinson township; Little Deer creek, West Deer township. These reports go before the next grand jury, and if approved the bridges will be erected.

BALTIMORE, MD.—The county commissioners have received the following bids for building a bridge over Bear Creek: Wrought Iron Bridge Co., for iron draw and approaches, $8,200 and $10,700; for all iron, $14,200 and $16,185; Youngstown Bridge Co., $10,794, $10,294 and $8,984; Campbell-Zell Co., $9,800, $14,000 and $13,500; Douglass & Co., $8,875 and $13,000. The contract was not awarded.

GRIFTON, N. C.—The senate has authorized the construction of a bridge across Contentnea Creek in this town.

BARBERTON, O.—Plans are being prepared for a bridge 30 to 35 ft. wide, over the Erie tracks at Strawboard crossing; estimated cost, $5,000.

EAST LIVERPOOL, O.—J. C. Kerr, contractor of this city, began work Dec. 24 on the abutments on the West Virginia side for the proposed bridge across the Ohio River at this place. The channel span will be 650 ft. Only enough work will be done now to hold the franchise, but it is stated that in April or May the construction will be commenced in earnest.

INDIANAPOLIS, IND.—Press reports state that R. B. F. Pierce, Gen. Man. Indiana, Decatur & Western R. R., will soon let a number of important contracts, among them bridge work estimated to cost $80,000. An iron structure will be placed over the Wabash River, 1,000 ft. in length, and new bridges will be built over Raccoon, Leatherwood, Big Eagle and White Lick creeks, cash to be paid on completion of the work. A new roof is now being placed on the roundhouse, costing $1,500, and other improvements are to be made to the shops. The entire passenger equipment, which is now equipped with the Eames vacuum brake, is to be equipped with the Westinghouse air-brake, and the freight equipment is being rebuilt as fast as it can be put through the shops.

PORT HURON, MICH.—Bids are asked until Feb. 1 for the construction and erection of a steel swing bridge and approaches, with substructure complete, including a protection pier, over Black River in this city. The bridge will have a swing span of 160 ft., 18-ft. roadway, 6-ft. sidewalks and the approaches will consist of 220 ft. of steel trestle work 32 ft. wide. The bridge will have an elevation of 17.4 ft. above the river and will carry a load of 100 lbs. per sq. ft. Thos. M. Danger, Supt. Pub. Wks.

VIRGIL, ILL.—It is reported that a new steel bridge is to be erected over the Kiswaukee River near the drainage ditch, where the road between Sycamore and St. Charles crosses.

CALEDONIA, WIS.—The contract for building the new Welsh bridge across the Baraboo River has been awarded to the Wisconsin Bridge & Iron Wks. The bridge will be 110 ft. long.

NORTH BEND, WIS.—A new bridge is soon to be built across Black River at this place, according to reports.

SIOUX CITY, IA.—The pontoon bridge at this place is reported to have been carried away.

ST. LOUIS, MO.—The East St. Louis & St. Louis Bridge & Construction Co. was incorporated in Illinois Dec. 27 to build a bridge across the Mississippi River; capital stock, $500,000; incorporators, H. D. Sexton, Geo. Schaub and John Niemann.

ARKANSAS.—Congressman Terry has introduced a bill to authorize the Little Rock & Pacific R. R. Co. to bridge the Fourche La Fevre and the Petit Jean rivers in Arkansas.

BEAUMONT, TEX.—A press report from this city states as follows: E. B. Cushing, Asst. Engr., and A. McDonald, Asst. Supt. of Bridges and Buildings, of the Southern Pacific, have gone to a point on the Neches River where the Southern Pacific is figuring on building a bridge for a contemplated branch road to the Angelina county rock quarries. The object of the road is to get rock for the Sabine Pass jetties. It is probable that the road will be built and this rock used.

GALVESTON, TEX.—Efforts are being made to organize a company to build the proposed $1,000,000 bridge across the bay. It is hoped to retain 51% of the capital stock of the company in this city and some $300,000 has already been pledged, according to reports.

MONTREAL, QUE.—The contract for building the bridge over the yard of the Canadian Pacific's east end station has been awarded to the Dominion Bridge Co., at $37,747.

TORONTO, ONT.—Bids are asked until Jan. 10 for

the construction of the pivot pier and abutments of a swing bridge over the Burlington Channel, near the city of Hamilton, according to plans and a specification to be seen at the custom house, Hamilton, at the office of the resident engineer, 36 Toronto St., Toronto, and at this office. E. F. E. Roy, Secy. Dept. Pub. Wks.

BUILDINGS.

BOSTON, MASS.—Plans have been made for a large warehouse to be erected for the F. L. Ames estate, according to reports, estimated to cost $400,000. Archs., Shepley, Rutan & Coolidge, Ames Bldg.

NEW YORK, N. Y.—The New York Central & Hudson River R. R. Co. has filed plans for two one-story stations, to cost $60,000, to be erected at 124th to 126th Sts., over Park Ave.

NEWARK, N. J.—Bids are asked until Jan. 24 for joinery work, wood flooring, marble work, vault doors, etc., for U. S. public building in this city, as stated in our advertising columns. Address Chas. E. Kemper, Acting Supervising Arch., Washington, D. C.

VINELAND, N. J.—A new $20,000 school building is to be erected in connection with the New Jersey Home for Feeble-Minded Children at this place.

PITTSBURG, PA.—J. D. Baker, of Baker & Maltby, proprietors of the Hotel Lafayette, Philadelphia, is reported to have secured a 60-days' option on the property now occupied by the plow works of A. Speer & Sons, with a view to erecting a hotel building thereon to cost $1,000,000.

BALTIMORE, MD.—It is reported that Joel Gutman & Co. will erect a five-story addition to their store, to cost about $150,000. Arch., Chas. E. Cassell, Law Bldg.

CHARLESTON, S. C.—Bids are asked until Jan. 15 for building an annex to the Charleston high school building. R. G. O'Neale, Secy. Trustees.

NEW ORLEANS, LA.—The council is considering an ordinance appropriating $100,000 for a court house.

LAKE PROVIDENCE, LA.—Bids are asked until Jan. 5 for the complete erection of a fireproof jail, to accommodate 20 prisoners; brick can be purchased near the building site at $8 per M. Yancey Bell, Clk. Police Jury, East Carroll Parish.

CLEVELAND, O.—It is stated that D. H. Burnham & Co., Chicago, are preparing plans for two store and office buildings in this city to cost $500,000 to $1,000,000 each. M. T. Herrick and Chas. Pack are interested in one and Henry C. Rouse, New York, Pres. Missouri, Kansas & Texas Ry. Co., is said to be owner of the other.

ZANESVILLE, O.—Contracts will be awarded in March, according to reports, for a $50,000 brewery. Arch., H. C. Lindsay.

INDIANAPOLIS, IND.—The Indianapolis Gas Co. is reported about to erect a $225,000 office building. Archs., D. A. Bohlen & Son, Brandon Building.

ROCHESTER, IND.—Plans are asked until Jan. 8 for a $70,000 courthouse. Wm. H. Deniston, Audr. Fulton County.

CHICAGO, ILL.—Geo. P. Bent has taken out a permit for the construction of a piano factory to cost about $60,000, at 17 to 31 Sangamon St.

SPARTA, WIS.—W. G. Williams and N. W. Huntley, of this city, are members of a committee appointed to secure plans and specifications for a new $50,000 court house to be built in this city.

ST. LOUIS, MO.—John E. Liggett is reported about to erect a $60,000 factory on Chestnut St., between 19th and 20th Sts. Archs., H. E. Roach & Son, 717 Chestnut St.

DALLAS, TEX.—Competitive plans are asked until Feb. 9 for a 50 × 95-ft. three-story and basement building to cost $35,000. The best three plans will receive prizes of $150, $100, and $50, respectively. Jos. Linz & Bro., 312 Main St.

WATER-WORKS.

NEWPORT, VT.—The committee has reported in favor of new works, with a supply from Derby Pond; estimated cost, $34,000. Engr., Joel Foster, Montpelier, Vt.; Consult. Engr., E. H. Gowing, Boston. C. A. Prout, Chn. Com.

DURHAM, CONN.—The Durham Center Water Co. has been incorporated, with a capital stock of $1,200, of which $500 has been paid in cash and $250 in real estate.

SEYMOUR, CONN.—The Citizens' Water Co. of this place has been organized and will apply for a charter.

TORRINGTON, CONN.—The water company has voted to increase its capital stock from $75,000 to $100,000. A new main will be laid and other improvements made.

WAKEFIELD, MASS.—The town has voted against accepting the act of the legislature permitting it to purchase the works, the vote being: Yes, 237; no, 373.

WEST HARTFORD, CONN.—The selectmen have prepared a petition to the legislature asking that the Hartford commissioners be compelled to extend the service to that place.

BROOKLYN, N. Y.—The commissioner of city works has petitioned for an appropriation of $1,250,000 for a new conduit and extensions to the mains.

CANANDAIGUA, N. Y.—E. G. Hayes, Secy., writes us that no action has been taken further than to appoint a board of water commissioners.

MONTGOMERY, N. Y.—A committee of five has been appointed to ascertain how many of the citizens are in favor of works. W. L. McKinney, Clk.

STAMFORD, N. Y.—The citizens are reported as trying to organize a company to put in new works, supply to be from Odell Lake. The present works were built in 1883 by the Stamford Water Co.

TARRYTOWN, N. Y.—Surveys are being made for the proposed new storage reservoir, recently noted. D. S. Merritt, Cy. Engr.

WILLIAMSVILLE, N. Y.—The citizens are reported as talking of building works to cost about $20,000.

WORTENDYKE, N. J.—The Northern Water Co. of New Jersey has been incorporated to construct works in the township of Franklin, Bergen county; capital stock, $10,000; incorporators, John B. Lydecker, East Rutherford, N. J.; Horatio W. Southworth, Wm. R. Wilcox, New York.

CHELTENHAM, PA.—The Edge Hill Water Co., noted Dec. 6, has been incorporated by E. F. Partridge, J. S. Keen, and others, of Philadelphia.

ERIE, PA.—It is reported that the intake will be extended next year, at a cost of $300,000.

McKEESPORT, PA.—A company is reported as being organized to supply this place and others in Western Pennsylvania with water from the Youghiogheny River.—The following bids were received last month for two deep well pumps: Epping, Carpenter & Co., Ltd., 2429 Penn Ave., Pittsburg, $675; J. B. Sheriff Mfg. Co., 68 Water St., Pittsburg, $788; H. M. Sciple, 807 N. 3d St., Philadelphia, $733; Deane Steam Pump Co., Holyoke, Mass., $806; Allen Bros., Ellis Ave., Allegheny, Pa., $669; Cook Well Co., St. Louis, $454; Downie Pump Co., Valencia, Pa., $639; Hill Machine Co., Anderson, Ind. (awarded contract), $600.

POTTSVILLE, PA.—The Good Spring Water Co. is reported to have been incorporated by stockholders of the P. & R. C. & I. Co. to suppy water in Porter township; capita stock, $2,500; Treas., Frank Carter.

WILKES BARRE, PA.—The Citizens' Water Co. was incorporated Dec. 31 to supply water in this city; capital stock, $1,000; Treas., D. O. McCullom.

WHITE MARSH, PA.—The White Marsh Water Co., noted in our issue of Dec. 6, has been incorporated by Philadelphia capitalists; capital stock, $1,000.

WRIGHTSVILLE, PA.—The Conewago Light & Water Power Co. is reported as arranging to supply this place and others in York, Berks, Dauphin, Cumberland, and Lancaster counties with water and light.

YORK, PA.—The York Haven Water & Power Co. has been organized to supply water and power to the boroughs of York Haven and Goldsboro and the intervening territory. It is proposed to secure power from the Conewago Falls in the Susquehanna River, where it is thought that 40,000 to 50,000 HP. can be obtained, and to furnish electric light and power in this city, Harrisburg, Steelton, Middletown, Columbia, Lancaster, and Lebanon. Henry L. Carter, Pres. York Haven Paper Co., is interested.

MOUNTAIN LAKE PARK, MD.—The Loch Lynn Milling Co. is reported as to put in works.

CUTHBERT, GA.—Contracts for the proposed works will probably be awarded in about a month. R. L. Moye, Mayor.

THOMASVILLE, GA.—The council has accepted a proposition of the Frictionless Metal Co. to put in new works to cost about $10,000, according to local papers.

PARIS, TENN.—The contract for constructing works and an electric light plant has been awarded to Guild & White, Chattanooga, according to reports, construction to be begun in April. Bonds for $32,000 will be issued.

CADIZ, O.—W. H. Lucas, Town Clk., writes us that the town has sold its $30,000 in water bonds for $30,692. An engineer will probably be engaged at a meeting of the council Jan. 7 and contracts awarded as soon as plans are completed; supply from wells; population, 1,800.

CELINA, O.—Plans and specifications will be made as soon as a water supply is secured. The preliminary steps have been taken. J. P. Le Bland, Pres. Trustees.

CHESANING, MICH.—The test wells for the new works are to be sunk at once, according to reports.

EATON RAPIDS, MICH.—The city has sold $35,000 in bonds for works and electric lights and it is stated that the construction of a plant will be commenced at once.

NILES, MICH.—The supreme court has decided that the $32,000 in bonds voted a year ago for works is in excess of the amount authorized by the charter of the city and that the council has no power to issue the bonds.

MARCELLUS, MICH.—It has been decided that the supply is not sufficient and nine more wells are needed, according to reports.

SHELBY, MICH.—Bids will soon be asked for constructing works, according to reports. Engr., Geo. C. Morgan, Chicago.

CHADWICK, ILL.—Bids were asked until Jan. 1 for constructing works. E. M. Humbert, Village Clk.

CHICAGO, ILL.—Local papers state that the bids for a 5,000,000-gallon pumping engine and boilers for the Lincoln Park pumping station ranged from $11,000 to $24,000, the bidders including the Holly Mfg. Co., Deane Steam Pump Co., Barr Pumping Engine Co., H. R. Worthington, J. B. Clow & Sons, Fraser & Chalmers, Stilwell-Bierce & Smith-Vaile Co.

KNOXVILLE, ILL.—H. J. Charles, H. J. Butt and M. H. Collins have been appointed to investigate the question of proposed works, as recently noted.

COLUMBUS JUNCTION, IA.—The question of works will soon be voted upon; population, 1,047.

FONDA, IA.—The town council is reported about to put in works, including a steel tower and tank.

LOGAN, IA.—F. H. McCabe, Recdr., writes us in regard to the proposed works that it is not known when definite steps will be taken.

SIOUX CITY, IA.—Bids for the Morning Side plant will be opened by the Sioux City Water Supply Co. very soon, according to local reports.

SMITHLAND, IA.—The "Exponent" is agitating the question of works.

CLARA CITY, MINN.—Bids are asked until Jan. 14 for the purchase of $15,000 in 6% bonds, voted for works at a special election Dec. 10. J. W. Tucker, Recdr.

DULUTH, MINN.—Bids are asked until Jan. 14 for the purchase of $304,000 in water and light bonds. O. E. Richardson, Clk. Council.

MINNEAPOLIS, MINN.—Bids are asked until Jan. 7 for a supply of cast iron water pipe. The bids published last week have been rejected. Chas. F. Haney, Cy. Clk.—The Mayor has signed the resolution authorizing an issue of $200,000 in bonds to begin work on the new reservoir.

STILLWATER, MINN.—Petitions have been presented asking for important extensions of the works.

COFFEYVILLE, KAN.—Tuttle & Pike, Kansas City, have reported in favor of a supply from the Verdigris River, the estimated cost being as follows: Two 1,250,000-gallon pumping engines, boilers, etc., $6,000; pumping station, $4,000; engineer's residence, $1,200; one 3,000,000-gallon reservoir and settling basin, $3,500; 200 ft. of 16-in. suction pipe, with appurtenances, $800; 500 ft. of 12-in. force main from pumping station to reservoir, $600; 9,000 ft. of 12-in. gravity main from reservoir, $10,000; 1,004 tons of pipe in distribution system at $23, $23,092; laying pipe, $11,830; stop valves, $717; 17½ tons of special castings, $1,050; 38 hydrants, $3,108; engineering and contingencies 10%, $6,656; total, exclusive of land, $73,213.

DEARBORN, MO.—It is stated that works will be put in.

FULTON, MO.—The city council is reported as considering the advisability of boring another artesian well.

GREENFIELD, MO.—It is reported that $3,000 in bonus will be voted for a deep well.

WAVERLY, MO.—There is talk of constructing works.

JONESBORO, ARK.—O. W. Anderson, Cy. Clk., writes us that the council is considering an offer of Jesse W. Starr to put in works to cost about $80,000; supply from deep wells; population, 4,000.

SILOAM SPRINGS, ARK.—A 50-year franchise for works, electric lights and an electric railway has been granted to E. T. Wisner, R. S. Morris and others, according to reports.

FORT WORTH, TEX.—Smith & Bondon, Fort Worth, were the lowest bidders for the three dams noted last week.

HOUSTON, TEX.—The Houston Water-Works Co. has voted to increase its capital stock from $600,000 to $1,200,000.

ALVA, OKLA.—There is talk of constructing works in this place.

VICTOR, COLO.—Pueblo papers state that Mitchell Bros., of Pueblo, have been awarded the contract for works in this city.

CORVALLIS, ORE.—Bids are asked until Feb. 1 for the purchase of $50,000 in 6% water bonds. J. M. Porter.

PORTLAND, ORE.—The committee has sold $100,000 in 5% 30-year water bonds to E. S. Heller, San Francisco, for $111,000.

HELENA, MONT.—Bids are asked until Jan. 8 for supplying the city with water for one to ten years. Stephen Carpenter, Cy. Clk.

WINNIPEG, MAN.—Walter Moberly, Engr., has proposed a water supply from the River English.

IRRIGATION.

HASTINGS, NEB.—The construction of an irrigation ditch is being discussed. A. L. Clarke, C. G. Lane, W. M. Dutton and W. A. Mackey have been inspecting the ditches at Culbertson.

PASCO, WASH.—Press reports state that the contract for the construction of the Pasco Canal, which will irrigate about 3,000 acres, will be let in a few days. This land will be opposite a valuable section; the water is from Strumpf Rapids.

HOLLISTER, CAL.—Thos. Flint, Sr., San Francisco, is interested in a scheme for irrigating land in the San Juan Valley. J. H. Shaw, Cy. Clk.

NEW COMPANIES.—Cozad Irrigation Co., Cozad Neb.; $100,000; A. M. Allen, David Clapool, and E. D. Owens.

Nebraska Irrigation & Power Co., Ord Valley county, Neb.; $250,000; F. E. Loyd, O. L. Horr, A. S. Rowan, H. E. Babcock.

SEWERS.

NEWPORT, ME.—The question of constructing sewers will probably be discussed at the March meeting of the town.

WOODSVILLE, N. H.—There is talk of constructing a system.

BELMONT, MASS.—Weaver, Holt & Parry have been awarded a contract for sewer construction at $13,544.

BROCKTON, MASS.—The council has passed an ordinance authorizing a sewer loan of $30,000.

DEDHAM, MASS.—J. R. Bulard, H. W. Chaplain and T. H. Wakefield, who were appointed a committee to report on a system, have recommended that the town build a system estimated to cost $150,000.

HARTFORD, CONN.—James Campbell has been awarded a contract for constructing a sewer in three streets, at $4,792, the other bidders being Michael O'Neil, $4,900, and the Hartford Construction Co., $5,936.

CHARLOTTE, N. Y.—Bids are asked until Jan. 15 for constructing 23,585 ft. of 18 to 6-in. pipe sewers and 8,000 ft. of 5-in. house connections, as stated in our advertising columns. C. A. Derr, Chn.; William Richmond, Clk.

TROY, N. Y.—The committee has voted to recommend the construction of brick sewers in several streets.

WILLIAMSBRIDGE, N. Y.—M. S. Mack has prepared plans for a system. The plans have been submitted to the state board of health and will be voted upon later by the citizens. R. Wallace, Village Clk.

JERSEY CITY, N. J.—Bids have been received from the following for constructing 24 and 20-in. sewers in two streets: Andrew Shaw, Sheridan & Shea Co., Graham Van Keuren, P. H. Flaherty, Jr., & Co., Thos. Wood, Patrick John Mullery, Edward O'Neill, Thomas McNeill.

ROSELLE, N. J.—The people have voted to organize this place into a borough, one of the objects being to enable them to construct a sewer to tidewater.

SEA ISLE CITY, N. J.—The construction of a system to cost $10,000 is being agitated.

MEADVILLE, PA.—Bids are asked until Jan. 16 for the construction of a sewage pumping station. W. R. Vance, Cy. Clk.

SCRANTON, PA.—The city engineer is preparing plans and estimates for a sewer in district No. 17, estimated to cost $30,000.

WASHINGTON, D. C.—Bids were opened by the district commissioners Dec. 26 for building the northern section of Rock Creek intercepting sewer. The following were reported as the bidders: B. J. Coyle, R. H. Lamb, Andrew Gleason, E. G. Gunnell, J. McCandlish, Lyons Bros., J. F. Kennedy and P. M. Lesher & Son.

CLEVELAND, O.—It is estimated that the cost of constructing a joint city and Glenville sewer will be $124,000, of which Glenville would pay $46,000.

COLUMBUS, O.—The council has passed an ordinance for the construction of a 15 and 12-in. pipe sewer in Davies St. J. M. Doane, Cy. Clk.

HAMILTON, O.—Bids are asked until Jan. 8 for constructing a sewage pumping station. J. J. McMaken, Cy. Clk.

LIMA, O.—The committee has recommended that R. H. Gamble, Cy. Engr., be directed to make a topographical survey for a complete system, but it is reported probable that no action will be taken this winter.

FORT WAYNE, IND.—F. M. Randall, Cy. Engr., has been directed to prepare plans for a system to drain Shawnee Run, estimated to cost about $100,000.

SYCAMORE, ILL.—The construction of a system is being discussed.

DES MOINES, IA.—The following bids have been received for constructing a system in the southeast portion of the city:

James F. Hanrahan & Co.	$6,000
Fleming & Co.	4,400
King & Kennedy	3,375
Bryan & Youngerman	6,359
W. M. Wright & Co.	5,549
Tim O'Brien	5,395
B. B. Rourk	3,470
Kavanagh & O'Connell	3,402

MINNEAPOLIS, MINN.—Press reports state that the annual report of the sewer engineer shows that there were laid in 1894 10.55 miles of sewers, at a cost of $270,650.

FARGO, N. DAK.—Bids are asked until Jan. 21 for constructing a pipe sewer in two streets. A. O. Rupert, Cy. Audr.

KANSAS CITY, MO.—The board of public works is considering an ordinance for creating sewer district 32. The territory of the district includes that part of the city between Wabash and Kansas Aves. and 22d and 27th Sts.

GARBAGE DISPOSAL.

BRIDGEPORT, CONN.—The board of health is reported to have decided to send a committee to other cities to investigate the question of garbage disposal. The "News" urges that a garbage crematory be secured.

BROOKLYN, N. Y.—The following bids were received at Washington, Dec. 24, for the construction of a garbage and refuse crematory at the Brooklyn navy yard:

	Framed in Wood.	Steel
Thos. Dwyer, 27 E. 128th St., N. Y.	$10,760	$11,160
Engle Sanitary & Cremation Co., Des Moines, Ia.	6,485	6,975
Thos. H. Stanley & Co., New York	4,700	5,800
Jas. McFerran, West Troy, N. Y.	7,600	8,100
P. J. Carlin & Co., Brooklyn	6,200	7,200
J. M. Brosnan & Bro., New York	6,150	6,150

ROCHESTER, N. Y.—The contract with the Rochester Reduction & Fertilizer Co. has been extended until April 1. Under the old contract the company was to have begun the operation of its plant last week, but the protest of the taxpayers in the vicinity of the proposed plant and the action of the council have delayed matters.

CAMDEN, N. J.—Bids are asked until Jan. 9 for the erection of a garbage crematory of a daily capacity of 60 tons (postponement of date from Dec. 26). J. B. Fox, Chn. Com.

McKEESPORT, PA.—The building enclosing the garbage crematory was burned Dec. 25. The furnace had not been placed in complete operation, according to reports.

PHILADELPHIA, PA.—The "Record" states that the Philadelphia Chemical Incinerating Co. has contracted with M. V. Smith, Pittsburg, for a $50,000-garbage incinerator, to have a daily capacity of 200 tons. The company has purchased a site at Cedar and Somerset Sts., and the plant is to be in operation within 60 days.

STREETS AND ROADS.

BROOKLYN, N. Y.—Bids are asked until Jan. 10 for flagging sidewalks in 18 streets. A. T. White, Comr. Cy. Wks.

JERSEY CITY, N. J.—Bids are asked until Jan. 7 for 3,750 sq. yds. of asphalt paving on concrete foundation, 200 cu. yds. rock excavation, etc. G. T. Bouton, Clk. St. Comrs.

BRISTOL, PA.—The macadamizing of the principal roads of the county is being discussed.

EASTON, PA.—The committee is discussing the question of paving Northampton St. with bricks from Central Square to Lawall's crossing, which the city engineer estimates will cost $6,000, or to Fifth St., estimated to cost $9,000.

HUNTINGDON VALLEY, PA.—The residents of several of the townships of Montgomery county are discussing the question of borrowing $50,000 to $100,000 for macadamizing the principal roads. Andrew Ervin and Harrison Woodward, Huntingdon Valley; Watson Bavrington, Somerton, and G. W. Quigley, Willow Grove, are the originators of the movement. Samuel Houpt, Willow Grove, and G. S. Lott, are on a committee to petition the court to call an election to vote on the proposition.

COVINGTON, KY.—Bids are asked until Feb. 4 for the purchase of $31,400 of asphalt paving bonds. J. T. Von Hoene, Cy. Clk.

BATAVIA, O.—Bids are asked until Jan. 15 for constructing 6½ miles of roads in Clermont county. J. W. Davis, Audr.

SOUTH BEND, IND.—The council has adopted resolutions for issuing $13,500 of 6% bonds for paving Jefferson St.

DUBUQUE, IA.—The paving of Clay St. with brick in the spring is being discussed, estimated to cost about $60,000, one-third of which will be paid by the Dubuque St. Ry. Co.

ST. PAUL, MINN.—The following bids were received Dec. 24 for paving Third St. from Broadway to Waconta: With granite: Thomas Reilly, $8,900; James Forrestal Co., $8,062; Fielding & Shepley, $6,600. Asphalt, Hennessey & Cox, $10,612; Warren-Scharf Asphalt Paving Co., $9,190.

SEDALIA, MO.—It is reported that the streets are to be paved.

HOUSTON, TEX.—Bids are asked until Jan. 14 for constructing sidewalks of cement, brick, stone, or asphalt in 17 streets. J. T. Browne, Mayor.

MISCELLANEOUS CONTRACTS AND SUPPLIES.

TELEPHONE SYSTEM.—Centerville, S. Dak.—It is stated that a telephone system will soon be put in.

DRAINAGE CANAL BONDS.—New York, N. Y.—Bids are asked until Jan. 9 for the purchase of $4,000,000 in bonds of the Sanitary District of Chicago. Thos. F. Judge, Clk.

TIMBER.—Toronto, Ont.—Bids are asked until Jan. 10 for the right to cut the pine timber on about four square miles in the district of Algoma. A. S. Hardy, Comr. Crown Lands.

RAILWAY TRESTLE.—New York, N. Y.—Bids are asked until Jan. 21 for building about 2,000 ft. of single track railway trestle at Sandy Hook, N. J. Jas. M. Moore, Dep. Q. M. Gen., U. S. A.

GRAIN ELEVATOR.—Union, Minn.—It is stated that a grain elevator of 30,000 bushels capacity is to be built at Wells, Minn., by A. L. Taylor, and contracts have been placed for the building.

LOCOMOTIVES AND CARS.—Cincinnati, O.—Press reports state that the Cleveland, Cincinnati, Chicago & St. Louis Ry. Co. is considering the purchase of six new locomotives, 100 stock cars, and 500 box cars.

CARS.—New York, N. Y.—The award of the contract for 750 box cars and 450 coal cars for the New York & New England R. R. has been indefinitely postponed, and awaits the action of the reorganization committee.

DREDGING.—Buffalo, N. Y.—The council is considering an appropriation of $63,000 for dredging Buffalo Creek, at South Buffalo, as a precaution against spring floods. With other improvements contemplated, it may be necessary to spend $100,000.

ELEVATORS.—New York, N. Y.—The lowest bids for the construction of two elevators in the custom house were those of Morse, Williams & Co., Philadelphia, at $12,907 for two hydraulic elevators, and the Sprague Electric Elevator Co., New York, at $10,710 for two electric elevators.

ARANSAS PASS JETTIES.—Rockport, Tex.—A press report from this city, Dec. 26, states as follows: A meeting of the stockholders of the Deep Water Co. was held last Friday at San Antonio, at which it was agreed to accept the offer of Messrs Brown, of Baltimore, New York, and London, to construct a breakwater and jetties at the pass. A meeting was called for Dec. 29 at Rockport to begin the renewal of subscriptions to the $640,000 bonus demanded. At a meeting Dec. 24 a committee was appointed to solicit subscriptions. Nueces county is expected to raise its share—in fact, has already secured a fair subscription. The Willet deep sea pier, to be constructed on Padre Island, is regarded as a joke.

CANAL WORK.—Albany, N. Y.—The following bids were received Dec. 20 for improving about 275 lin. ft. of the Champlain Canal, and rebuilding waste-weir of Erie Canal; contract awarded to Pidgeon & Co., as stated in our issue of last week:

Cunningham & Monty, Sandy Hill, N. Y.	$11,029
John Turney, Schenectady, N. Y.	9,926
J. P. Kelly, Troy, N. Y.	14,204
Ernest Flagler, Lansingburg, N. Y.	10,129
J. W. Whalen, Whitehall, N. Y.	12,018
Pidgeon & Co., Albany, N. Y.	9,542
Jeremiah Adams, Whitehall, N. Y.	10,078
Troy Public Works Co., Troy, N. Y.	10,283

NAVY YARD IMPROVEMENTS.—Brooklyn, N. Y.—The lowest bids received at the navy department, Washington, Dec. 24, for improvements at the Brooklyn navy yard, on which a total of about $500,000 is to be expended, were as follows: Garbage and refuse crematory, Thomas H. Stanley & Co., New York, $4,700, framed in wood, or $5,800, framed in steel; bending shop building No. 114, J. M. Brosnan & Bro., New York, $20,000; quay wall, foot of Main St., Stratford, Hawkes & Co., Brooklyn, $80.40 per lin. ft., and J. M. Brosnan & Bro., New York, $36,950 for the whole; quay wall, Whitney basin, Stratford, Hawkes & Co., Brooklyn, $24,073; causeway across Wallabout Channel, Delaware Construction Co., Wilmington, Del., $75,168; extension of boiler shop, building No. 28, Leonard Bros., Brooklyn, $27,230; reconstruction building No. 6, M. Gibbons & Son, Brooklyn, $40,975.

BRAZOS JETTIES—Velasco, Tex.—Press reports from this city state as follows: The reorganization of the companies composing the syndicate here for completing the Brazos jetties and the development of the port of Velasco terminated with the conference that has been held here several days for the arrangement of all details and the election of the following officers: Brazos River Channel & Dock Co.—Pres., Abner Taylor, of Chicago; Vice-Pres., Horatio G. Curtis, of Boston; directors, Abner Taylor, Charles B. Farwell, E. S. Dreyer, of Chicago; H. G. Curtis, J. Otis Wetherbee and William H. Coolidge, of Boston; R. L. Heflin, of New Orleans; Ira H. Evans, of Austin, Tex.; Eugene J. Wilson, of Brazoria, Tex.; J. M. Ferguson and G. W. Angle, of Velasco. For the Texas Land & Immigration Co.—Pres., Horatio G. Curtis; Vice-Pres., J. O. Wetherbee; directors, H. G. Curtis, J. O. Wetherbee, Abner Taylor, C. B. Farwell, R. L. Heflin, E. S. Dreyer, W. H. Coolidge, W. M. D. Lee, of Leavenworth, Kan., and E. M. House, of Austin, Tex. For the Velasco Terminal Ry. Co.—Pres., Chas. B. Farwell; Vice-Pres., H. G. Curtis and Eugene J. Wilson; directors, Guy M. Bryan, Jr., of Bryan, Tex.; J. M. Moore, of Velasco; E. J. Wilson, E. M. House, C. B. Farwell, H. G. Curtis and J. O. Wetherbee. E. D. Dorchester, of Boston, was chosen secretary and assistant treasurer, and J. M. Moore, of Velasco, treasurer of all these corporations. Work will be resumed at once upon the jetties and other harbor improvements, and there is no doubt of its being rushed to completion as rapidly as possible.—Another report states that F. A. Brock, Galveston, has the contract for completing the jetties.

CONDENSED LIST OF CONTRACTS PENDING WITH DATE OF OPENING BIDS.

Bids to be opened.	Work.	Place.	See Eng. News.
Jan.	2. U. S. building at Atlanta, Ga.		Dec. 13
	Advertised, Eng. News, Dec. 13 and 20.		
Jan.	2. Receiving well, etc.,	Hamilton, O.	Dec. 27
Jan.	3. Dredging (200,000 cu.yds.),	New York	Dec. 20
Jan.	3. Gas and el.lt. fixtrs (5bidgs),	Washington	Dec. 20
Jan.	3. School building,	Buffalo, N. Y.	Dec. 27
Jan.	3. Pipe sewers,	Newark, N. J.	Dec. 27
Jan.	3. Electric light plant,	Toronto, Ont.	Dec. 27
Jan.	4. Breakwater,	San Francisco, Cal.	Dec. 13
Jan.	4. Gas lighting,	Brooklyn, N. Y.	Dec. 27
Jan.	4. Water-works system,	Woodstock, Ll.	Dec. 27
Jan.	4. Disposal of sewage,	Denver, Colo.	Dec. 27
Jan.	4. Electric lighting,	Brooklyn, N. Y.	Dec. 27
Jan.	5. Pine timber,	St. Louis, Mo.	Dec. 13
Jan.	5. Jail,	Lake Providence, La.	Jan. 3
Jan.	7. Cement, stone, etc.,	Wilmington, N. C.	Dec. 6
	Advertised, Eng. News, Dec. 6 to 27.		
Jan.	7. Water bonds,	Detroit, Mich.	Nov. 15
Jan.	7. Plans for city hall,	Cohoes, N. Y.	Dec. 13
Jan.	7. Bridge,	Meridian, Miss.	Dec. 20
Jan.	7. Bridges (6),	Leavenworth, Kan.	Dec. 20
Jan.	7. Bridge,	Toledo, O.	Dec. 20
Jan.	7. Pipe sewers,	Albany, N. Y.	Dec. 27
Jan.	7. Cast iron pipe,	Baltimore, Md.	Dec. 27
Jan.	7. Electric lighting,	Kansas City, Kan.	Dec. 27
Jan.	7. Wooden bridges,	Creston, Ia.	Dec. 27
Jan.	7. Asphalt paving,	Jersey City, N. J.	Jan. 3
Jan.	7. Electric lighting,	Grand Rapids, Mich.	Jan. 3
Jan.	7. Cast iron pipe,	Minneapolis, Minn.	Jan. 3
Jan.	8. Bridge plans,	Buffalo, N. Y.	Dec. 13
Jan.	8. Dredging and excav.,	Wilmington, Del.	Dec. 20
	Advertised, Eng. News, Dec. 20 to Jan. 3.		
Jan.	8. Interior finish, etc.,	Rockford, Ill.	Dec. 20
	Advertised, Eng. News, Dec. 20 and 27.		
Jan.	8. Cement,	Halifax, N. S.	Dec. 20
Jan.	8. Brick sewer,	Buffalo, N. Y.	Dec. 27
Jan.	8. Rebuilding bridge,	Houghton, Mich.	Dec. 27
Jan.	8. Sewage pumping station,	Hamilton, O.	Jan. 3
Jan.	8. Plans for court house,	Rochester, Ind.	Jan. 3
Jan.	8. Water supply,	Helena, Mont.	Jan. 3
Jan.	9. Drainage canal bonds,	Chicago, Ill.	Jan. 3
	Advertised Eng. News, Jan. 3.		
Jan.	9. Brick paving,	Cincinnati, O.	Dec. 20
Jan.	9. Park bonds ($200,000),	Cleveland, O.	Dec. 27
Jan.	9. Drainage canal,	Chicago, Ill.	Dec. 27
Jan.	9. Garbage crematory,	Camden, N. J.	Jan. 3
Jan.	10. Water-works system,	Astoria, Ore.	Dec. 13
	Advertised, Eng. News, Dec. 20 to Jan. 3.		
Jan.	10. Hire dredge and snag boat,	New Orleans.	Dec. 20
Jan.	10. Water bonds ($200,000),	Astoria, Ore.	Dec. 20
Jan.	10. Life-sav'g station,	Monmouth Beach, N. J.	Dec. 27
	Advertised, Eng. News, Dec. 27 and Jan. 3.		
Jan.	10. Water-works system,	Decatur, Mich.	Dec. 13
Jan.	10. Flagging (17 Sts.),	Brooklyn, N. Y.	Jan. 3
Jan.	10. Right to cut timber,	Toronto, Ont.	Jan. 3
Jan.	10. Bridge piers, etc, near	Hamilton, Ont.	Jan. 3
Jan.	12. Hotel building,	Medford, Wis.	Dec. 13
Jan.	12. Piles and dredging,	Portland, Ore.	Dec. 27
Jan.	14. Sale of iron and stee plant,	Chester, Pa.	Jan. 3
Jan.	14. Piles,	Sioux City, Ia.	Dec. 27
Jan.	14. Water bonds ($15,000),	Clara City, Minn.	Jan. 3
Jan.	14. Water bonds,	Duluth, Minn.	Jan. 3
Jan.	14. Sidewalks,	Houston, Tex.	Jan. 3
Jan.	15. Steam boilers, etc.,	New York,	Dec. 27
	Advertised, Eng. News, Dec. 27 and Jan. 3.		
Jan.	15. Water-works system,	Brightwood, Ind.	Dec. 27
	Advertised, Eng. News, Dec. 27 to Jan. 10.		
Jan.	15. Bridge superstructure,	Warren, O.	Dec. 27
Jan.	15. Pipe sewers (23,585ft.),	Charlotte, N. Y.	Jan. 3
	Advertised, Eng. News, Jan. 3.		
Jan.	15. High school annex,	Charleston, S. C.	Jan. 3
Jan.	15. Roads (6½ miles),	Batavia, O.	Jan. 3
Jan.	16. Jetty,	San Francisco, Cal.	Dec. 27
Jan.	16. Sewage pumping station,	Meadville, Pa.	Jan. 3
Jan.	17. Removing shoals,	Burlington, Vt.	Dec. 20
	Advertised, Eng. News, Dec. 20 to Jan. 10.		
Jan.	18. Dredging, etc.,	Philadelphia, Pa.	Dec. 27
Jan.	18. Sidewalk bonds,	Pleasant Ridge, O.	Dec. 27
Jan.	21. Laying water pipe,	New Orleans, La.	Dec. 27
	Advertised, Eng. News, Dec. 27 to Jan. 17.		
Jan.	21. Cast iron pipe (42 to 16-in.),	Cleveland, O.	Dec. 27
Jan.	21. Street Ry. franchise,	Hartwell, O.	Dec. 27
Jan.	21. Bridge bonds, ($200,000),	Toledo, O.	Dec. 27
Jan.	21. Water-works system,	Milan, Ill.	Dec. 27
	Advertised, Eng. News, Dec. 27 to Jan. 10.		
Jan.	21. Railway trestle (2,000 ft.),	New York.	Jan. 3
Jan.	21. Pipe sewer,	Fargo, N. Dak.	Jan. 3
Jan.	22. Electric light plant,	Melbourne, Aus.	Dec. 27
Jan.	23. Electric light franchise,	Winnipeg, Man.	Dec. 6
Jan.	23. Gas franchise,	Winnipeg, Man.	Dec. 6
Jan.	23. Tow and dredge boat,	St. Louis, Mo.	Dec. 27
	Advertised, Eng. News, Dec. 27 to Jan. 10.		
Jan.	24. Sale Hamilton, Ont., Bridge Co.'s plant.		Dec. 20
	Advertised, Eng. News, Dec. 20 to Jan. 17.		
Jan.	24. Dredging machinery,	Portland, Ore.	Dec. 27
	Advertised, Eng. News, Dec. 27 to Jan. 17.		
Jan.	24. Building materials,	Newark, N. J.	Jan. 3
	Advertised, Eng. News, Jan. 3 and 10.		
Jan.	25. Asphalt paving,	Ottawa, Ont.	Dec. 27
Feb.	1. Electric lighting,	Corry, Pa.	Dec. 13
Feb.	1. Water supply	Corry, Pa.	Dec. 13
Feb.	1. Gas plant,	Peoria, Ill.	Dec. 27
	Advertised, Eng. News, Dec. 27.		
Feb.	1. Electric light plant,	Peoria, Ill.	Dec. 27
	Advertised, Eng. News, Dec. 27.		
Feb.	1. Steel swing bridge,	Port Huron, Mich.	Jan. 3
Feb.	1. Water bonds ($50,000),	Corvallis, Ore.	Jan. 3
Feb.	4. Bridge,	Natchez, Miss.	Dec. 13
Feb.	4. Paving bonds ($31,400),	Covington, Ky.	Jan. 3
Feb.	9. Building plans,	Dallas, Tex.	Jan. 3
Feb.	11. Jail,	Beaumont, Tex.	Dec. 13
Feb.	15. Stone dam,	Holyoke, Mass.	Dec. 13
	Advertised, Eng. News, Dec. 13 to Jan. 24.		
Feb.	19. Torpedo boats,	Washington, D. C.	Dec. 6

CONTRACT PRICES.

CAST IRON PIPE.—Dallas, Tex.—R. W. Haven, City Engr., writes us that the following bids were received Dec. 20 for furnishing 15,000 ft. of 30-in. cast iron water pipe, the price being per ton of 2,000 lbs. f. o. b. Dallas:

Addyston Pipe & Steel Co., Cincinnati	$24.00
Chattanooga Foundry & Pipe Wks., Chattanooga.	19.80
Howard Harrison Iron Co., Bessemer, Ala.	22.00
Anniston Pipe Co., Anniston, Ala.	20.65

PUMPING ENGINE.—La Crosse, Wis.—The following bids were received by the board of public works Dec. 13 for a 10,000,000-gallon pumping engine: Holly Mfg. Co., Lockport, N. Y., specifications A, $32,000; H. R. Worthington, New York, specifications B, $31,875; E. P. Allis Mfg. Co., Milwaukee, specification A, 42-in. stroke, $34,200; Geo. F. Blake Mfg. Co., 7 bids, $44,900 to $59,900.

SEWERS.—Pittston, Pa.—Bids were opened Dec. 20 for constructing a system of sewers in West Pittston, as advertised in Engineering News. The general conditions are: Character of digging, loam; average depth, 6 ft.; underlaid with gravel; no rock, boulders or quicksand; vitrified pipe, single strength up to 20-in., remainder double strength; brick sewers, 8-in., inner ring to springing line laid in Portland cement; concrete bottom in egg-shaped sewers; right reserved to omit construction of any portion of the work; monthly payments, 85%; time of completion, July 1, 1895. The total bids were as follows:

McGarry & McGowan, Akron, O.	$36,460
George Acock & Son, Trenton, N. J.	39,266
Ryan & Avery, Watertown, N. Y.	39,553
A. Emonson, Carlisle, Ark.	39,603
Headley & Christie, Newark, N. J.	42,320
T. H. Ryan, North Tonawanda, N. Y.	42,377
Corcoran & Connell, Pittsburg, Pa.	43,022
William Franklin, Buffalo, N. Y.	43,320
A. W. Bryne, West Medfrod, Mass.	44,531
Henry M. Dowd & Co., Orange, N. J.	45,482
P. J. Cleary, Shenandoah, Pa.	45,780
James McCloud & Co., Williamsport, Pa.	46,161
Coon, Mooney & Co., Kingston, Pa.	46,268
Sanders & Houston, Pittsburg, Pa.	46,463
Lindsay & Van Loon, Plymouth, Pa.	47,073
Dunn Bros., Scranton, Pa.	47,916
Hart & Gibbons, Wilkesbarre, Pa.	51,152
Batton & Van Bussum, New York city.	51,373
Brodhead & McConville, Scranton, Pa.	54,350
R. C. Mitchell, Plains, Pa.	54,929
Fred. Hurdler, Wilkesbarre, Pa.	56,671
T. M. Lesher & Son, Easton, Pa.	62,064
Sullivan Bros., Philadelphia, Pa.	68,999

The lowest bid for the pipe sewers was that of (1) George Acock & Son, of Trenton, N. J., and for the total work that of (2) Daniel McGarry and Stephen McGowan, of Akron, O., the prices of these bids being as follows; Engrs., Potter & Folwell, Pittsburg:

			1.	2.
For trenching, backfilling and laying:				
8-in. pipe, under 8 ft.,	6,685 ft.,	per ft.	$0.33	$0.40
8-in. pipe, 8 to 10 ft.,	3,992 "	" "	.38	.42
8-in. pipe, 10 to 12 ft.,	635 "	" "	.43	.50
8-in. pipe, 12 to 14 ft.,	1,225 "	" "	.48	.60
8-in. pipe, 14 to 16 ft.,	330 "	" "	.53	.70
8-in. pipe, 16 to 18 ft.,	250 "	" "	.58	.85
8-in. pipe, 18 to 20 ft.,	455 "	" "	.63	.90
12-in. pipe, under 8 ft.,	180 "	" "	.43	.50
12-in. pipe, 8 to 10 ft.,	750 "	" "	.48	.50
15-in. pipe, 7 to 12 ft.,	4,332 "	" "	.52	.60
18-in. pipe, under 8 ft.,	565 "	" "	.63	.70
18-in. pipe, 8 to 12 ft.,	950 "	" "	.68	.85
20-in. pipe, under 8 ft.,	600 "	" "	.75	.80
20-in. pipe, 8 to 12 ft.,	1,200 "	" "	.80	.90
22-in. pipe, under 8 ft.,	350 "	" "	.86	.90
22-in. pipe, 8 to 10 ft.,	1,000 "	" "	.91	.95
24-in. pipe, under 8 ft.,	1,230 "	" "	1.23	1.25
24-in. pipe, 8 to 10 ft.,	500 "	" "	1.28	1.35
24-in. pipe, 12 to 14 ft.,	400 "	" "	1.38	1.50
30-in. pipe, under 8 ft.,	540 "	" "	2.24	2.20
30-in. pipe, 10 to 16 ft.,	940 "	" "	2.40	2.60
30-in. pipe, 20 ft.	325 "	" "	2.69	3.10
8 × 6-in. Y's	406	each	.25	.25
12 × 6-in. Y's	30	"	.45	.43
15 × 6-in. Y's	139	"	.65	.63
18 × 6-in. Y's	48	"	.90	.85
20 × 12-in. Y's	58	"	1.20	1.13
30 × 12-in. Y's	51	"	4.75	4.40
22 × 12-in. Y's	40	"	1.50	1.38
24 × 12-in. Y's	63	"	3.00	2.28
			$19,598	$21,600
Brick sewers:				
28 × 42-in., 12 to 16 ft.,	260 ft.,	per ft.	$3.60	$2.45
28 × 42-in., 16 to 20 ft.,	410 "	" "	3.74	2.75
30 × 45-in., 10 to 16 ft.,	1,205 "	" "	3.62	2.40
34 × 51-in., under 8 ft.,	485 "	" "	3.77	2.50
34 × 51-in., 8 to 12 ft.,	325 "	" "	3.91	2.60
40 × 60-in., under 8 ft.,	363 "	" "	4.23	2.90
40 × 60-in., 8 to 10 ft.,	375 "	" "	4.37	2.95
36-in., 10 to 6 ft. deep.,	150 "	" "	3.32	2.50
50-in., 8 to 13 ft. deep,	257 "	" "	4.51	3.00
			$14,762	$10,019
Appurtenances:				
Flush tanks	8,	each.	$30.00	$27.00
Manholes, less than 10 ft.	37	"	25.00	24.00
Extra depth	24	pr.ft.	3.00	2.40
Intersecting,	18,	each.	30.00	30.00
Drop	7	pr.ft.	3.00	3.00
Covers, c. i., etc.	38,600	pr.lb.	.02	.02
Deep cut cnctns., 400 ft.	85,	each.	.25	.25
Lampholes	2,	each.	12.00	10.00
Catch basins,	44		50.00	50.00
Oak timber (foundat'ns),	1,000	M. ft.	30.00	30.00
Hemlock sheathing	5,000	"	15.00	15.00
			$4,906	$4,841
Total			$39,137	$36,460

CAST IRON AND STEEL PIPE.—Cambridge, Mass.—The following bids were received Dec. 20 for cast iron and riveted steel water pipe, as advertised in Engineering News: Plan A, all cast iron—R. D. Wood & Co., 40-in. bell and spigot ends, 5,473 tons at $22.65; flanged ends, 176 tons, $34; 30-in., 7 tons; 20-in., 14 tons; 12-in., 19 tons; 6-in., 2 tons, all bell and spigot ends, $22.65; special iron castings, 75 tons, $51.50 and $75; total bid, $135,048. Warren Foundry & Machine Co., 40-in. bell and spigot ends, $24.50 to $23.25; 40-in. flanged ends, $35; 30-in., $23.75; 20-in., $24.25; 12-in., $24.50; 6-in., $25.50; special castings, $50; total, $139,655. McNeal Foundry & Pipe Co., 40-in. bell and spigot ends, $23.03; 40-in. flanged ends, $34.80; 30 to 6-in., $23.03; special castings, $50.40, $78.40 and $100.80; total, $139,677. Plan B—40-in., 2,100 tons and 14 tons; special castings, 35 tons; other quantities and bids for same, as per Plan A; totals, $51,815, $53,455 and $54,389, respectively; also the following bids for riveted steel pipe:

Bids Received at Cambridge, Mass., for 40-in Steel Riveted Pipe.

		Carroll Porter Boiler & Tank Co., Pittsburg, Pa.	*Rochester Bdge & Iron Works, Rochester, N. Y.	Riter & Conley, Pittsburg, Pa.	Howard Kendall & Sons, Cambridgeport,	P. A. & R. G. Gillespie, Pittsburg, Pa.	Groton Bridge & Mfg. Co., Groton, N. Y.	McKee & Milson, Paterson, N. J.
40-in. steel lap joint	14,300 lin. ft.	$4.50	$4.68	$4.92	$5.20	$5.39	$5.75	$5.89
40-in. steel-flanged ends	784 " "	5.00	3.91	4.83	6.37	5.72	5.50	5.56
94.5 ft. special section, in place	1	1,000.00	1,170.00	985.00	1,000.00	862.00	1,080.00	1,153.00
78.0 ft. special section, in place	2	650.00	700.00	670.00	5.75	624.00	680.00	1,572.00
20-in. T's on 40-in. pipe	2	20.00	40.00	15.00	30.00	35.00	13.00	30.00
12-in. T's on 40-in. pipe	1	20.00	30.00	12.00	25.00	22.00	7.50	31.00
30-in. valves in line 40-in. pipe,	4 sets.	50.00	140.00	100.00	50.00	100.00	25.00	125.00
Tangent blow-off, 40-in. pipe	4	20.00	35.00	14.00	25.00	30.00	11.00	30.00
Manholes on 40-in. pipe	14	15.00	28.00	23.00	25.00	24.50	12.00	35.00
*Special fitting, 40-in. pipe	20,000 lbs.	.05	.05	.06	.07	.05	.04	.06
Total		$72,120	$74,761	$78,488	$83,003	$85,626	$90,122	$95,286

* Wrought iron or steel.

HIRE OF DREDGING PLANT.—Buffalo, N. Y.—Maj. B. H. Ruffner, U. S. Engr. Office, opened bids Dec. 31 for the hire of a dredging plant on the improvement of Tonawanda Harbor and Niagara River, for which there is an appropriation of $50,000. There were but two bidders: Hingston & Woods, Buffalo, agreed to furnish dredge for $52 a day; tug, $18.40; drill boat, $52; towing and sounding scow, $14.60. Carkin, Stickney & Cram, Saginaw, Mich., $100; $20; $5; $50.

SPECIAL CASTINGS.—Minneapolis, Minn.—The following bids were received last month for a supply of special castings, the price being per ton of 2,000 lbs.:

Standard Foundry	$47.50
S. T. Ferguson	33.50
South Park Foundry & Machine Co.	36.00
Union Iron Works	34.58

TEST BORINGS.—Buffalo, N. Y.—Maj. E. H. Ruffner, U. S. Engineer Office, opened bids Dec. 27 for test borings on the line of the Buffalo breakwater to Stony Point. W. S. Bartlemes and W. C. Hiam, Buffalo, bid 74 cts. per lin. ft.; W. B. Wilson, Buffalo, $2.25; John H. Stock, Forks, N. Y., $2.50; Logie & Leh, Buffalo, $4.30. The appropriation for the work is $5,000.

SEWERS AND BRICK PAVING.—East St. Louis, Ill.—Several references have been made to the bids received for reconstructing over a mile of Eighth St., estimated to cost over $100,000. Alex. E. Abend, Cy. Engr., informs us that the contract was awarded on Dec. 17 to Francis M. McCabe, Union Trust Bldg., St. Louis, for Wabash repressed block, made by the Wabash Clay Co., Veedersburg, Ind. The price for 29,000 sq. yds. of paving on 5 ins. novaculite was $1.28 per sq. yd., the itemized bids being as follows:

Bids Received at East St. Louis, Ill., for Reconstructing About One Mile of Eighth St.

		Casp. Stolle, E. St. Louis.	Wade Bros. & Podeski, St. Louis.	Skrainka Construction Co., St. Louis.	F. McCabe, St. Louis.	Hill & O'Meara, St. Louis.	Fruin-Bambrick Co., St. Louis.	R. M. Quigley & Co., St. Louis.	Stiefel & Ruckert, St. Louis.	Allen & Viethe, St. Louis.
From Broadway to St. Louis Ave.:										
Filling, per yd.	36,300 cu.yds.	$0.615	$0.44	$0.43	$0.33	$0.32	$0.49	$0.52	$0.41	$0.42
Limestone curb'g, 4 × 24-in. set	3,000 lin. ft.	.55	.48	.50	.52	.45	.49	.55	.47	.60
30-in. vit. sewer pipe, 46 cons.	1,600 " "	1.77	2.00	1.91	1.85	1.87	1.95	2.10	1.73	2.12
10-in. vit. sewer pipe laid	300 " "	.24	.40	.18	.19	.22	.19	.23	.14	.24
6-in. vitrified sewer pipe, laid.	2,000 " "	.09	.20	.10	.11	.10	.10	.15	.07	.10
Tunnel for 30-in. pipe	220 ft.	2.00	.80	.90	2.25	3.00	1.29	1.00	2.50	2.00
Excav. and refilling	1,032 cu.yds.	.23	.26	.25	.22	.15	.18	.20	.17	.24
Brick in cesspools, etc.	28,000	12.75	10.50	14.00	14.00	13.00	9.77	11.50	13.50	14.00
Stone inlets, 5 ft. × 5 ft. × 10 ins.	8	14.00	3.00	13.75	17.00	15.00	12.25	13.00	14.00	14.00
Manhole covers, cast iron	4	15.00	15.00	10.50	12.00	13.00	....	8.50	12.75	11.50
Brick paving		1.43 to 1.60	1.25	1.55 to 1.64	1.28	1.42 to 1.50	1.40 to 1.65	1.60	1.39 to 1.83	1.47 to 1.52
From St. Louis Ave. to Exchange Ave.:										
Filling, per yd.	17,000 cu.yds.	.52	.44	.39	.34	.32	.53	.52	.41	.42
Excav. to be placed in fill	2,300 " "	.20	.10	.20	.17	....	.20	.17	.22	.24
Limestone curbing, 4 × 24-in. set	10,500 lin. ft.	.55	.50	.50	.52	.45	.49	.55	.47	.60
30-in. vit. sewer pipe laid	4,000 " "	1.70	2.00	1.91	1.85	1.87	2.07	2.10	1.73	2.12
24-in. vit. sewer pipe, laid	550 " "	.90	1.00	.95	.95	1.00	.97	.95	.83	.86
18-in. vit. sewer pipe laid	1,050 " "	.51	.45	.50	.50	.61	.55	.52	.42	.48
10-in. vit. sewer pipe laid	1,040 " "	.21	.30	.19	.19	.20	.23	.23	.14	.24
6-in. vit. sewer pipe laid	4,338 " "	.065	.20	.12	.11	.10	.12	.15	.07	.10
Excav. and refilling for sewer	5,700 cu.yds.	.20	.30	.25	.22	.15	.22	.20	.17	.24
Brick in cesspools, etc.	51,000	12.75	10.00	14.00	14.00	13.00	9.77	11.50	13.50	14.00
Stone inlets, 5ft. × 5ft. × 10 ins.	28	13.00	3.00	10.50	17.00	15.00	12.25	13.00	14.00	14.50
Manholes, cast iron	16	15.00	12.50	13.75	12.00	13.00	....	8.50	12.75	11.50

PUMPING ENGINE.—Grand Rapids, Mich.—The following bids were received Dec. 17 for a 15,000,000-gallon pumping engine: Fraser & Chalmers, Chicago, 4 bids, 3 on vertical engines, $39,900, $40,000 and $61,380, of 36, 42 and 48-in. stroke, and 1 on a horizontal engine, $34,600, of 36-in. stroke; Nordberg Mfg. Co., Milwaukee, 2 bids on horizontal engines, $32,000 and $33,500, of 48 and 60-in. stroke, and 1 on a vertical engine, $48,000, of 60-in. stroke; Snow Steam Pump Works, Buffalo, $65,000 for a vertical engine of 60-in. stroke, and $61,000 for a horizontal engine of 48-in. stroke; Geo. F. Blake Mfg. Co., New York, $90,000 and $100,000 for vertical engines of 48 and 60-in. stroke respectively; E. P. Allis Mfg. Co., Milwaukee, $64,000 and $56,000 for vertical engines of 60 and 48-in. stroke, respectively; A. J. L. Loretz, Brooklyn, vertical engine, 33-in. stroke, $38,000; Holly Mfg. Co., Lockport, N. Y., $33,667 for a horizontal engine of 170 piston speed and 38-in. stroke, and 8 bids, ranging from $47,554 to $58,200, on vertical engines, 200 to 300 piston speed, with 48 to 60-in. stroke; Henry R. Worthington, New York, $35,875 and $41,750, both on vertical engines of 200 piston speed and 36-in. stroke. The lowest bid for remodeling the old Butterworth engines was that of $22,600, by Fraser & Chalmers. The Nordberg Mfg. Co. bid $25,000 and A. J. L. Loretz $23,750. The old pump could be forced to pump 14,000,000 gallons per day, while the new pump will raise 17,000,000 gallons with ease. The board of public works has contracted with the Nordberg Mfg. Co. for a new pump, at $33,500. Local papers describe the pumping engine as follows: It is to be a triple-expansion, horizontal engine with a guaranteed duty of 145,000,000 ft.-lbs., which means that for every 100 lbs. of coal burned it is warranted to raise 145,000,000 lbs. one foot. If it shall not do this the cost of the excessive coal required to raise that weight during 20 years is to be deducted from the purchase price. The high-pressure cylinder will be 21 × 48 ins.; intermediate cylinder, 37 × 48; low-pressure cylinder, 55 × 48; three double-acting, outside packed, plunger pumps, the cylinders of each to be 16½ × 48, with an inlet and outlet valve area each of 2,430 sq. ins.; piston speed, 320 ft. per min.; steam pressure, 125 lbs.; weight, 620,000 lbs.; pump to be running by June 1.

DREDGING.—Rock Island, Ill.—The following bids were received by Maj. A. Mackenzie, U. S. Engineer Office, Dec. 28, for dredging in Quincy Bay, Ill.:

	Per cu. yd.
H. S. Brown, Quincy, Ill.	13¼ cts.
Charles H. Appleton, Stillwater, Minn.	14½ cts.
William A. Kirk, Madison, Ia.	14⅝ cts.
A. J. Whitney, Rock Island, Ill. (accepted).	8 9-10 cts.

FIRE HOSE.—Buffalo, N. Y.—The fire commissioners have awarded to the Eureka Hose Co., New York, a contract for 10,000 ft. of 2½-in. solid woven cotton rubber lined fire hose, at 90 cts. per ft.

ARMOR PIERCING SHELLS.—Washington, D. C.—The following bids were received at the navy department Dec. 24, according to press reports, for supplying 400 semi-armor piercing shells for the 13-in naval rifles: Midvale Steel Co., 25 cts. per lb.; Sterling Steel Co., 25 cts., and the Carpenter Steel Co., 24½ cts.

RUBBLE STONE PAVING.—Camden, N. J.—The following bids were received Dec. 26 for paving Clinton St. from Fourth St. to Broadway with the best assorted rubble stone, (1) being the price per square yard for grading and paving and (2) price per square yard for repaving, including gutters and crossings; B. H. Shivers, Clk. St. Dept.:

	1.	2.
Wm. H. Sherman (awarded contract)	$.78	$.99
Thos. A. Wilson	.78	.12
B. F. Sweeten & Son	.87*	.13

* Lambertville stone, 87 cts.; Brandywine, $1.25.

ELECTRIC LIGHTING.—Millville, N. J.—L. H. Hogate, Cy. Recdr., writes us that the only bid received for electric street lighting during 1895 was that of the Millville Electric Light Co., at $65 for arc lights and $25 for incandescent lights from January to July, and $75 and $36 respectively, from July to January, 1896.

RAILWAY TIES.—Hinesburg, Vt.—Daniel Patrick, of this place, has been awarded a contract for 10 000 ties for the Burlington & Hinesburg Ry. at 20 cts. each, ties to be 8 ft. long and at least 9 ins. in diameter, according to reports.

METAL MARKET PRICES.

LEAD.—New York: 3.05 to 3.1 cts. Chicago: 2.85 cts. St. Louis: 2.8 to 2.85 cts.

NAILS.—Pittsburg: 90 to 95 cts. for wire, and 80 cts. for cut at mill in carload lots.

BARBED WIRE.—Pittsburg: galvanized, $1.90; plain, $1.25, for carloads at mill.

FOUNDRY AND PIG IRON.—New York: $10.00 to $13.00. Pittsburg: $10.50 to $11.25. Chicago: $9.50 to $10.50.

TRACK MATERIAL.—New York: angle bars, 1.25 to 1.4 cts.; spikes, 1.45 to 1.6 cts.; track bolts, 2 to 2.1 cts. with square, and 2.15 to 2.3 cts. with hexagon nuts. Chicago: angle bars, 1.3 to 1.35 cts.; spikes, 1.6 to 1.7 cts.; track bolts, 1.9 to 2 cts., with hexagon nuts.

RAILS.—New York: $22 at eastern mills and $22.75 at tidewater; old rails, $10.00 for iron, and $9.00 for steel; steel rails fit for relaying, $14.00; light rails, $20 to $22; girder rails, $24. Pittsburg: $22 for standard sections of 45 lbs. and over; old rails, $12 for iron and $9 to $11 for steel. Chicago. $23 for standard sections; old rails, $10.75 to $11 for iron, and $8 to $9 for steel.

STRUCTURAL MATERIAL.—New York: beams, 1.3 to 1.5 cts.; channels, 1.35 to 1.5 cts.; angles, 1.2 to 1.35 cts.; tees, 1.4 to 1.6 cts.; universal mill plates, 1.2 to 1.35 cts.; steel plates, 1.25 to 1.4 cts. for tank, 1.4 to 1.45 cts. for shell, 1.5 to 1.65 cts. for flange, 1.75 to 2 cts. for ordinary firebox, 2 to 2.25 cts. for locomotive firebox. Pittsburg: beams, 1.25 to 1.35 cts.; channels, 1.25 to 1.35 cts.; angles, 1.1 to 1.2 cts.; tees, 1.35 cts.; universal mill plates, 1.1 to 1.2 cts.; steel plates, 1.15 to 1.25 cts. for tank, 1.3 to 1.35 cts. for shell, 1.35 to 1.4 cts. for flange, 2.5 to 3.75 for ordinary firebox, and 3.35 to 3.5 cts. for locomotive firebox. Chicago: beams, 1.45 to 1.5 cts.; channels, 1.45 to 1.5 cts.; angles, 1.35 to 1.4 cts.; tees, 1.65 cts.; universal plates, 1.35 to 1.4 cts.; steel plates, 1.35 to 1.4 cts. for tank, 1.5 to 2 cts. for flange, 2 to 4.5 cts. for firebox.

INDUSTRIAL NOTES.

A TIN PLATE FACTORY at Converse, Ind., is proposed by O. W. Conner, Wabash, Ind., and others.

THE INDUSTRIAL IRON WORKS, at Fort Howard, Wis., were destroyed by fire Dec. 18, involving a loss of $12,000.

THE ADAMANT PLASTER WORKS, at East Omaha, Neb., were destroyed by fire Dec. 28, involving a loss of $10,000.

THE FIRMINICH GLUCOSE PLANT at Marshalltown, Ia., had its dry house destroyed by fire Dec. 21, involving a loss of $60,000.

THE BALDWIN LOCOMOTIVE WORKS, of Philadelphia, Pa., have delivered two freight engines to the Zanesville & Ohio River R. R.

THE KING BRIDGE CO., of Cleveland, O., has the contract for an iron mill building for the Longmead Iron Works, at Conshohocken, Pa.

THE KEITH MFG. CO., of Sagamore, Mass., has orders for 100 coal cars and 100 box cars for the New York, New Haven & Hartford R. R.

A COLD STORAGE PLANT is proposed for Titusville, Pa., and the Board of Trade of that city is endeavoring to raise $15,000 for the purpose.

THE SHIFFLER BRIDGE CO., of Pittsburg, Pa., has a contract for a solid-floor plate girder bridge over the Philadelphia & Reading R. R. at Philadelphia.

A BREWERY of 10,000 barrels capacity is proposed for Lyons, N. Y., and a company is to be organized with $50,000 capital. Morgan Taylor, of Lyons, is interested.

THE EAST TENNESSEE TELEPHONE CO. will build a new telephone line from Morgantown, Tenn., to Rochester. Gen. Man., R. M. Easley, of Bowling Green, Ky.

A TIN PLATE FACTORY, with a capacity of 3,000 boxes per week, is to be erected at Ellwood, Ind., by a St. Louis company recently organized with a capital of $200,000.

THE FRANKFORD STEAM FORGE WORKS, of Philadelphia, Pa., has commenced the construction of new works at Elwood City, Pa., which will employ about 200 men.

A SEWER PIPE FACTORY is being erected at Appleton, Wis. The building is a two-story brick structure, and T. E. Johnston has the contract for the mason work.

A TIN PLATE FACTORY is reported as to be established at Franklin, Ind., by a company with $250,000 capital. The Franklin Land Co. can probably supply further information.

A PINTSCH GAS PLANT for the manufacture of compressed oil gas for car lighting is to be established at Houston, Tex., by the Southern Pacific Ry., to supply the cars on the Atlantic system.

THE TOTTEN & HOGG IRON & STEEL CO., of Pittsburg, Pa., has the contract for the tin plate machinery of the new plant of the Baltimore Steel & Tin Plate Co., of Baltimore, Md.

THE CARNEGIE STEEL CO., of Pittsburg, Pa., is said to have purchased land at Lorain, O., near the works of the Johnson Co., noted last week, where it will establish extensive steel works.

THE CORNING STEEL CO. will resume operations at its sheet steel mill at Hammond, Ind., about Jan. 10, after having been shut down for nearly three years. The works employ 350 men when running at full capacity.

THOMAS CARLINS' SONS, manufacturers of contractors' plant, have completed their new works on River St., at Allegheny, Pa. The works include a machine shop, 100 × 100 ft., three stories high; foundry, 60 × 200 ft., and boiler shop, 40 × 116 ft.

A RAMIE DECORTICATING PLANT is to be established at Tallahassee, Fla., by S. B. Allison, inventor of the decorticating machine, and A. L. Center, both of New Orleans, La. It is proposed to organize a stock company, with a capital of $200,000.

A STEEL PLANT is reported as to be established at Durango, Mexico, by the Huntington interests in the Mexican International Ry., as that road taps the great iron deposits near that city, and the company has acquired the right to work the mines.

THE BOUGHEN ENGINEERING CO., of Cincinnati, O., has made an assignment. The reason given is that payment for several water-works built by the company has been made in bonds which have not matured and cannot therefore be realized upon.

THE BERLIN IRON BRIDGE CO., of East Berlin, Conn., has the contract for a fireproof annealing room, 94 × 175 ft. for the Naugatuck Malleable Iron Co., of Naugatuck, Conn., and has completed a boiler house for the Metropolitan Electric Co., of Reading, Pa.

THE EMPIRE STATE ELECTRICAL FORGING CO. has been organized at Syracuse, N. Y., to operate under the patents controlled by the United States Electric Forging Co., of New York. W. L. Fairchild is interested and W. J. Morrison represented the latter company.

THE GREER RAILROAD SPIKE CO. has been organized to undertake the manufacture of the Greer spike, formerly manufactured by Morris Sellers & Co. The company's office is in the Western Union Building, Chicago, Ill. This spike was described and illustrated in our issue of March 19, 1892.

THE REX MILL CO., of Kansas City, Kan., will build new and enlarged flour mills, with a capacity of 3,000 to 4,000 barrels per day. There will also be extensive grain elevators, grain warehouses and a cooperage plant. Complete systems of water supply and electric light will be put in. Pres., J. M. B. Kehlor, of St. Louis, Mo.

JOHN ACTON, of Brooklyn, N. Y., has built two 20-in. back pressure valves for the Edison station in Chicago, and two 24-in. water-works reducing valves. The latter were for the Hendrie & Bolthoff Mfg. Co., of Denver, Colo., and used on the San Diego, Cal., water-works. These are said to be among the largest valves of this class ever built.

THE GRIFFIN WHEEL & FOUNDRY CO., of Buffalo, N. Y., will, it is said, establish a branch wheel foundry at Denver, Colo., for its Western and Mexican business, as already noted. Plans have been prepared for shops to cost $250,000, which would have a capacity of 200 wheels per day, and contracts for pig iron, coal and coke are said to have been made with the Colorado Fuel & Iron Co.

THE SAGINAW CLAY MFG. CO., of Saginaw, Mich., has been organized by Isaac Bearinger, R. W. Roberts, John Scanlan and others, with a capital of $25,000, to manufacture paving and pressed brick, drain tile and sewer pipe, terra-cotta fireproofing and firebrick. The company owns deposits of fireclay and shale, and will put up a plant with a capacity of 25,000 to 30,000 paving and pressed brick per day.

THE DRAKE & STRATTON CO. has been organized at Philadelphia, Pa., to undertake mining, railway construction, etc. The capital is $500,000, with $500 paid in, and the incorporators include J. Wainwright and W. W. Fortune, of Pittsburg, Pa., and Malcolm Jackson, of Charleston, W. Va. The company has been awarded the contract for the masonry for the Delaware River bridge of the Pennsylvania R. R. Co., as noted under Bridges.

THE ST. LOUIS IRON & MACHINE WORKS, of St. Louis, Mo., state that they are building one of their heavy St. Louis Corliss engines of 700 HP. for the Union Depot Street Ry. Co., of St. Louis; a high-duty engine of 600 HP. for the Consolidated Steel & Wire Co., of Allentown, Pa.; a cross-compound engine of 800 HP. with cylinders 26 × 50 × 48 ins. for Kansas City parties, and one of 300 HP. for the Bloomington Electric Light Co., Bloomington, Ill.

CAR WORKS AND STEEL WORKS are to be established at Salmon Bay, near Seattle, by a company in which D. H. Gilman, of that city, is interested. It is said that there will be a coke blast furnace and charcoal furnace of 80,000 lbs. annual capacity each, an open-hearth steel plant of 50,000 tons and a bar mill of 50,000 tons capacity. The president is Smith M. Weed, of Plattsburgh, N. Y. The plant is to be driven by electric power transmitted from the Snoqualmie Falls, for which another company has been organized.

THE WELLMAN IRON & STEEL WORKS, at Chester, Pa., are to be sold Jan. 12, on the premises. The plant includes blast furnace, Bessemer and open-hearth steel plant, plate and blooming mills, machine shop and tools, engines, boilers, etc.; also locomotives, cars, stock, pig iron, etc. There are about 38 acres of land and 1,100 ft. of river front, with a large pier and dock. The plant is equipped with modern labor-saving machinery, is in good condition, and has what is said to be the largest three-high plate mill in the world. Receiver, W. B. Broomall.

THE AMERICAN SIGNAL CO., of Baltimore, Md., manufacturing the road crossing signal illustrated and described in our issue of June 28, 1894, writes us that a special meeting of the stockholders on Dec. 24, the capital stock was increased $15,000. It is the intention of the management to make some improvements at the works at Thurmont, Md., in the way of enlarging the buildings and increasing the facilities for manufacturing, as the past year has been a very successful one, and the company has, to a certain extent, outgrown the capacity of its present plant. The business during the past year was such as to justify the board in declaring a dividend of 10% for the fiscal year ending Dec. 11, 1894. The stockholders at their meeting Dec. 12 re-elected the old Board of Directors, which board re-elected the following officers: Pres. and Gen. Man., Geo. W. Smith; Vice-Pres., Wm. M. Stewart; Secy. and Treas., H. O. Hartzell; Supt., Richard O'Toole.

NEW COMPANIES.—San Diego Bitumen Water Pipe Co., San Diego, Cal.; $25,000, with $20,000 paid in; Charles H. Brown, James H. Guion and James M. Hartley.

Shoenberger Steel Co., Pittsburg, Pa.; $1,800,00, all subscribed; Treas., John M. Brownson.

Spring Motor Co., Dixon, Ill.; $150,000; W. M. Boolt, Robert Ryan and J. V. Paulson.

Urbana Mfg. & Supply Co., Urbana, O.; $10,000; tools and machinery; L. G. Black, Daniel Wilson and H. M. Allen.

White Mfg. Co., New York, N. Y.; $20,000; railway castings and appliances; E. C. White, C. A. Lieb and W. H. MacCarthy.

Wisconsin Construction Co., St. Paul, Minn.; $75,000; Geo. Fuller and S. E. Hall, of St. Paul; M. P. Barry, Rice Lake, Wis.

Pacific Oil Refining & Supply Co., Los Angeles, Cal.; $200,000, all subscribed; T. W. Brotherton, A. G. Williams and G. E. Harpham.

McKee & Webb Mfg. Co., Cortland, N. Y.; foundry and machine works; $15,000; John L. McKee, Arthur Webb and Thomas Smith.

Mela Fireproof Partition Co., of New York city; $25,000; Ferdinand H. Mela, Christian G. Norman and Nathan Kohn, of New York city.

William James Sons Co., Hinton, W. Va.; $500,000, with $150,000 paid in; lumber, bridges, etc.; W. W. James, J. C. James and J. H. Miller.

New Martinsville Natural Gas Co., New Martinsville, W. Va.; $200,000, with $30,000 paid in; G. W. Crawford, W. R. Fitch and W. P. Simmonds.

Southampton Brick & Tile Co., of Southampton, N. Y.; capital, $10,000; Wm. T. Graham, James E. Jennings and H. M. Howell, of Southampton.

Equity Oil Co., Wheeling, W. Va.; $100,000, with $10,000 paid in; John Bradley and Hugh F. Boles, of Pittsburg, Pa.; L. E. Hampsher, of Bradford, Pa.

Ohio Mining & Mfg. Co., Jersey City, N. J.; $2,200,000, all subscribed; Aymar Embury, of Englewood, N. J.; W. E. Danes, Demarest, N. J., and W. R. Willcox, New York, N. Y.

IRON AND STEEL MARKET.

The following review of the condition of trade in this line is from the Philadelphia "Press":

The year's business may now be said to be closed, and while there are some encouraging features, there are others that are rather disquieting. Compared with this time a year ago, considerable progress has been made so far as regards recovery in the volume of business, and prospects indicate further improvement on that line, the chief source of anxiety being in regard to prices.

Pig metal and steel billets are about $1.50 a ton lower than they were a year ago, and finished material about $3 lower. Considering that various little reductions have been made in the cost of production, and that at least 50 to 75% more business is being done, the lower selling prices are measurably offset, but there is a feeling of instability and uncertainty that discourages buyers, especially because considerably better prices were realized four or five months ago. High water mark was reached during August and September, but since then there has been a steady decline on everything, except on foundry and ordinary mill irons. Bessemer is particularly weak and from $14 prices have melted away, until $12 is now a full average quotation. Billets have lost $3, and finished material from $3 to $5 per ton. It should be remembered, however, that the advance was largely due to strikes in the coke and soft coal regions, so that the decline is not due to any falling off in the demand, but because of a gradual return to normal conditions. Nevertheless, the fact of such a steady decline with no immediate indications of a reaction cannot but have its effect, and while there is a disposition to regard the outlook favorably, extreme conservatism is noticable everywhere.

Many well informed people regard the rail trade as likely to become an important factor during the coming year, but it is to be feared that if that is their reliance, they will be doomed to disappointment. Last year was expected to be good, but it fell below the year previous, this year was expected to be better, but it also falls below the year previous, the total output being less than 750,000 tons for the eleven months ending Nov. 30. From 1880 to 1885, inclusive, the deliveries averaged 1,279,000 tons per annum. In 1887, 2,139,000 tons; 1888, 1,403,700 tons; 1889, 1,522,204 tons;;1890, 1,885,000 tons; 1891, 1,307,000 tons; 1892, 1,551,000 tons; 1893, 1,136,000 tons; eleven months, 1894, 750,000 tons.

There are several reasons for believing that the demand will not be much if any larger than during 1894. First, because all the roads are poor, and will not spend a dollar more than is absolutely necessary. Second, because they are not satisfied that prices are at the lowest, and third, the capacity for turning out rails is so great that there is no necessity for making long contracts. Railway managers are, therefore, satisfied that their requirements can easily be met at present prices, with a not improbable contingency of being able to do still better later on. There may be a favorable change with the new crop year, but until there is some certainty of improvement in the condition of the West and Northwest, it will not be safe to calculate on a big demand for rails. The same may be said of railway equipments generally, but as cars and locomotives wear out more rapidly than rails, there may be, and perhaps will be, a relatively better demand for rolling stock than for roadbed equipments. At present, however, prospects in these departments are anything but bright.

Bridge work is active, and structural work generally promises a great deal of work during the early spring months. Boiler and tank work is also absorbing a good deal of material, and the small trade generally are steady buyers, the aggregate being quite important.

Briefly stated, the situation may be summarized as follows: Volume of work 60% heavier than at this time a year ago, the prospects for 1895 in about the same proportion, i. e., 60% better than at the close of 1893. Prices 10 to 12% lower than a year ago, prospects in regard to same uncertain.